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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by G. O. Bachman, R. A. Cadigan, F. W. Cater, Joan R. Clark, R. R. Coats, Georgianna D. Conant, Margaret Cooper, H. R. Cornwall, S. C. Creasey, Eleanor J. Crosby, W. C. Culbertson, S. E. Frezon, E. E. Glick, R. E. Grant, Wanda L. Grimes, Andrew Griscom, B. C. Hearn, J. J. Hemly, R. K. Hose, J. W. Hosterman, Virginia M. Jussen, B. H. Kent, E. H. Lathram, Marie L. Lindberg, Elisabeth S. Loud, E. K. Maughan, E. D. McKee, Mildred C. Mead, A. T. Miesch, D. R. Mullineaux, Virginia S. Neuschel, L. L. Ray, M. W. Reynolds, A. E. Roberts, E. H. Roseboom, E. T. Ruppel, C. A. Sandberg, S. P. Schweinfurth, G. R. Scott, V. E. Swanson, R. W. Tabor, H. A. Tourtelot, J. G. Vedder, Dorothy B. Vitaliano, H. C. Wagner, W. S. White, R. E. Wilcox, R. G. Yates, and E-an Zen.

ABSTRACTS

1829 **Abbey, Sydney.** Determination of potassium, sodium and calcium in feldspars: Canadian Mineralogist, v. 8, pt. 3, p. 347–353, tables, 1965.

A combined flame photometric method is described for the determination of potassium, sodium and calcium in feldspars. Magnesium is used to minimize variations in the depressant effect of aluminum on calcium emission resulting from deviations from stoichiometry. Standard solutions, approximating the compositions of the sample solutions, are prepared from pure reagents. An analysis can be done on as little as 10 milligrams of sample.—Author's abstract

Adams, John A. S. *See* Rogers, John J. W. 1893

2137 **Adams, John Emery.** Stratigraphic–tectonic development of Delaware basin: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 2140–2148,illus., 1965.

The Delaware basin of southwestern Texas and southeastern New Mexico, originally part of western mid–Paleozoic Tobosa basin, began as a separate basin in Early Pennsylvanian as a result of high–angle faulting, and contains 20,000 feet of thin Pennsylvanian and very thick Permian clastics, carbonates, and evaporites and about 5,000 feet of Ordovician to Mississippian carbonates, cherts, and fine clastics. Rapid foundering occurred during early Permian which caused numerous secondary faults and folds and the uplift of surrounding areas into mountains. Deep basin sedimentation during lower Permian was by turbidity flows. Thin beds of continental Triassic and marine Lower Cretaceous and Upper Cretaceous were deposited. Uplifting, faulting, and minor igneous activity occurred during Tertiary and Quaternary. Large petroleum production has come from stratigraphic and structural traps ranging from Lower Ordovician to Upper Permian.—S.P.S.

Adolphson, Donald G. *See* Ellis, Michael J. 1840

1687 **Adrian, Donald Dean.** Turbulent flow in porous media [discussion of paper 4019 by J. C. Ward, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 321–323, table, 1965.

Mr. Adrian believes that the theory, as presented, is needlessly restricted to horizontal flow.—E.S.L.

2099 **Ahrens, L. H.** Introduction—The comparative geochemistry of potassium, rubidium, calcium, argon, strontium, uranium, thorium and lead, *in* Applied geochronology: London and New York, Academic Press, p. vi–xiv, illus., tables, 1965.

The amount of parent and daughter isotopes which may be found in a mineral or rock is controlled by several factors. The one with which this paper is concerned is the comparative geochemical behavior. Discussion is confined to those radioactive elements which are commonly used for geochronological purposes. Abundance data of these elements in chondrites, and of thorium and uranium in igneous rocks, are tabulated. The distribution of strontium in granite, and of uranium and thorium in zircons, is shown graphically.—E.S.L.

2063 **Alaska Geological Society.** Guidebook, field trip routes, Anchorage to Sutton, 1963; Sutton to Caribou Creek, 1964—Oil fields, earthquake, geology: Anchorage, Alaska, Alaska Geol. Soc., 36 p., illus., 1964.

These two trips follow the Knik and Matanuska Valleys. The first 15 pages are a reprint of the 1963 road log, and the remaining 21 pages, the additions prepared during 1964. Fold-in plates are used for route maps of both trips to show geology, and an airphoto of the Turnagain slide area. Six papers describe the geology of parts of the area.—E.S.L.

1808 **Albritton, Claude C., Jr.; Smith, J. Fred, Jr.** Geology of the Sierra Blanca area, Hudspeth County, Texas: U.S. Geol. Survey Prof. Paper 479, 131 p., illus., tables, geol. map, 1965.

A systematic account is given of local rock units, their structural relations, and their expression in the present landscape in an effort to reconstruct the history of an ancient boundary between a rigid structural platform (now part of the Basin and Range province) and a mobile geosynclinal belt (now part of the Sierra Madre Oriental). The two structural provinces have maintained their separate identities possibly since Precambrian times and unquestionably since Late Jurassic or Permian times. In this area, the rock record began during Early Permian and also includes Jurassic, Cretaceous, Tertiary, and Quaternary systems. Mineral resources are discussed briefly, and lithologic logs of wells drilled for oil and gas are given. V.S.N.

2025 **Alfors, John T.; Putnam, George W.** Revised chemical analyses of traskite, verplanckite and muirite from Fresno County, California: Am. Mineralogist, v. 50, no. 9, p. 1500–1503, tables, 1965.

The chemical analyses of traskite, verplanckite, and muirite (Alfors et al., 1965, Table 2) are revised subsequent to the detection of substantial chlorine in traskite and minor fluorine in all three minerals. In addition, new data were obtained which resulted in a revision of the water content of traskite and muirite, and in a slight revision of the silica and alumina content of all three minerals. The resulting revisions have changed the cell contents of verplanckite and muirite slightly and the cell content of traskite markedly.—Authors' abstract

Algert, James H. *See* Nordin, Carl F., Jr. 1693

1663 **Ames, L. L., Jr.** Zeolite cation selectivity: Canadian Mineralogist, v. 8, pt. 3, p. 325–333, illus., tables, 1965.

A proposal that cation selectivity of zeolites is mainly a function of anionic site separation distances was tested with high and low silica-to-alumina ratios of the same zeolite crystal structure (faujasite and Type A). Anionic site separation distances of the high silica zeolites were assumed to be relatively greater than the low silica zeolites. The high silica zeolites were considerably more cesium-selective from a sodium-cesium system than the lower silica zeolites, as expected. Strontium selectivity from a sodium-strontium system was generally greater with the low silica zeolites, but was complicated by anionic site separation distance heterogeneity.—Author's abstract

1908 **Anderson, Don R.** Biostratigraphy of Vicksburgian equivalent at Toledo Bend dam site, Louisiana and Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1752–1753, 1965.

Anderson, S. B. *See* Carlson, C. G. 2086

1917 **Anderson, Walter A.** Introduction to delta symposium [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1755, 1965.

2071 **Anderton, Peter W.; Bull, Colin.** Studies of the confluence of two glaciers in the Icefield Ranges, Yukon Territory [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 603, 1965.

1783 **Andrews, J. T.** Surface boulder orientation studies around the northwestern margin of the Barnes ice cap, Baffin Island, Canada: Jour. Sed. Petrology, v. 35, no. 3, p. 753–758, illus., 1965.

Orientations of boulders in ground moraines, in front of end or lateral moraines, and on outwash plains yield statistically significant preferred orientations which agree with other evidence of the direction of former glacier movements. Boulder orientation samples may be taken six to eight times as rapidly as conventional ground moraine fabric studies based on pebble orientations.—R.A.C.

Appel, Charles A. *See* Remson, Irwin. 1686

2028 **Applegate, Shelton P.** A confirmation of the validity of *Notorhynchus pectinatus*—The second record of this Upper Cretaceous cowshark: Southern California Acad. Sci. Bull., v. 64, pt. 3, p. 122–126, illus., 1965.

Shark teeth described here are from the Moreno Formation of the Panoche Hills, Fresno County, Calif. Applegate believes that the use of the genus *Notidanus* by Agassiz for the earlier discovery is regrettable, and a revision of the entire group should be undertaken. Possible scavenging habits of sharks are discussed.—E.S.L.

2128 **Armstrong, Frank C.; Oriel, Steven S.** Tectonic development of Idaho–Wyoming thrust belt: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1847–1866, illus., 1965.

The tectonic and sedimentary history of this structurally complex area in eastern Idaho and western Wyoming is summarized. Tectonic development is divided into three stages: The first, during Paleozoic and early Mesozoic, was a time of shifting patterns of tectonic elements; sediments, mostly marine, came from both east and west. The second started in the west in latest Jurassic, in part overlapped the first, ended in the east perhaps as late as early Eocene, and produced folds overturned toward the east and thrust faults dipping gently west. The third, started in Eocene time, has continued to the Recent, and is characterized by block faulting. Movement along many faults has been recurrent with possible reversed vertical movement along some north-trending faults. Present topographic relief is tectonic.—E.K.M.

2112 **Aronow, Saul.** [Ingleside barrier island system] *in* The deltaic Coastal Plain—Gulf Coast Assoc. Geol. Socs., 15th Ann. Mtg., 1965, Field Trip Guidebook: Houston, Tex., Houston Geol. Soc., p. 51–54, illus., 1965.

The altitude of the Ingleside barrier island system decreases toward the southwest, undoubtedly due to regional uplift and warping. The problem of the age and stratigraphy of the system is related to the associated Pleistocene formations. It is here considered to be a sandy facies of the Beaumont–Prairie, representing a temporary stabilization of sea level. An airphoto mosaic shows many Brazos distributaries in the area. Occurrence of pimple mounds on the Hoskins Mound barrier is discussed.—E.S.L.

1867 **Ash, Sidney R.** Upper Triassic plants of New Mexico and Arizona [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 185, 1964.

Ash, Sidney R. *See* Baltz, Elmer H. 1868

2062 **Ayres, Marshall G.** Regional geology of the Cook Inlet area, Alaska, *in* Guidebook, field trip routes, Anchorage to Sutton, 1963; Sutton to Caribou Creek, 1964—Oil fields, earthquake, geology: Anchorage, Alaska, Alaska Geol. Soc., p. 28–36, illus., 1964.

The area is similar to both the Pacific island arc system and continental orogenic belts. Late Paleozoic to early Mesozoic eugeosynclinal sediments were deposited in linear troughs subparallel to the present southern coast. In Early Jurassic time the site of the Alaska Range was uplifted and subjected to volcanism and plutonism. The site of the Chugach Range was concurrently downbuckled into a tectogene and intruded by plutonic rocks. Epeirogenic marine Mesozoic sediments and nonmarine

Tertiary sediments were deposited in the intermontane basin. Minor volcanism and plutonism has continued to the Recent. Post-orogenic warping and faulting cuts across former orogenic trends to adjust to the new continental edge formed by the Early Jurassic orogeny.—E.S.L.

1848 **Bachman, George O.** Southwestern edge of late Paleozoic landmass in New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 70–72, illus., reprinted 1964; originally published 1960.

Evidence of the Pedernal landmass is found at a dome near Bent in Otero County. On the east side of the dome the Permian Abo Formation rests on Precambrian rocks, on the west side the Abo overlies supposedly Pennsylvanian rocks, 200 feet thick. A sketch map and section show these relations. The paper originally appeared in U.S. Geological Survey Professional Paper 400B.—E.S.L.

Bair, F. L. *See* Bradford, G. R. 1811

Baird, A. K. *See* McIntyre, D. B. 1669

1557 **Baird, Donald.** Footprints from the Cutler Formation, *in* Early Permian vertebrates from the Cutler Formation of the Placerville area, Colorado: U.S. Geol. Survey Prof. Paper 503-C, p. C47–C50, illus., 1965.

Footprints occur in the Lower Permian Cutler Formation near Placerville, Colo. *Limnopus cutlerensis* n. sp., a small species similar to the Late Pennsylvanian *L. vagus* of Kansas, is ascribed to an eryopoid labyrinthodont. A korynichniid pes imprint similar to that of *Brachydactylopus* represents a small diadectid cotylosaur. Early Permian red beds ichnofaunas are quite different from contemporaneous dune-sand ichnofaunas; the latter represent tetrapod faunas of which skeletal records are lacking. Three specimens of fossil footprints in the Museum of Comparative Zoology provide supplementary information on the tetrapod fauna of the Cutler Formation. . . .—Author's abstract

1868 **Baltz, Elmer H.; Ash, Sidney R.** The Cretaceous-Tertiary boundary, San Juan Basin, New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 185, 1964.

2135 **Baltz, Elmer H.** Stratigraphy and history of Raton basin and notes on San Luis basin, Colorado-New Mexico: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 2041–2075, illus., 1965.

The Raton basin, Colorado-New Mexico, was formed in Early Pennsylvanian time when downwarping produced geosynclinal basins bordered on the west by the San Luis uplift. The border zone was uplifted in early and middle Tertiary time to form the Sangre de Cristo uplift; then in middle and late Tertiary time the San Luis uplift was tilted eastward, and the eastern part foundered to form the San Luis basin. Still mainly untested, the Raton basin offers petroleum possibilities where thick Pennsylvanian and Cretaceous marine sediments may be source rocks and potential structural and stratigraphic traps are known to exist. Tertiary and Quaternary terrestrial sediments and interbedded volcanics in the San Luis basin discourage oil exploration.—B.H.K.

Barber, S. A. *See* Swartzendruber, D. 1819

1595 **Barker, F. B.; Johnson, J. O.; Edwards, K. W.; Robinson, B. P.** Determination of uranium in natural waters: U.S. Geol. Survey Water-Supply Paper 1696-C, p. C1–C25, illus., tables, 1965.

A method is described for the determination of uranium in natural waters at concentrations <1 microgram per liter on a sample of 10 ml or less. The method is based on the fluorescence of uranium in a pad prepared by fusion of the dried solids from the water sample with a flux of 10 percent NaF, 45.5 percent Na_2CO_3 and 45.5 percent K_2CO_3. Moderate concentrations of quenching elements can be

tolerated. Equations are given for the calculation of standard deviations of analyses, and graphs of error functions and representative data are included.—W.L.G.

Barnes, Robert H. *See* Larson, Lawrence T. 1678

1696 **Barnes, Robert H.** Mineral resources summary of the Vanleer quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 15 p., 1965.

This text to accompany Tennessee Div. Geology Geol. Map GM 48-NW by M. V. Marcher and C. P. Finlayson (cited separately) describes the iron ore and limestone in the Vanleer quadrangle. The iron ore deposits lie on the crests and slopes of ridges and spurs (at elevations ranging from 620 to 910 feet) which are generally covered with a thick mantle of weathered Mississippian residuum of chert, silt, and clay overlain by gravel, sand, and clay of the Cretaceous Tuscaloosa Formation. All ore is secondary, most is a variety of limonite, some is magnetic, and individual pieces may be as much as 3 feet in diameter. Excellent exposures of limestone in the Warsaw are of quarryable thickness. In most of its outcrop belt, the St. Louis is covered by a thick residuum so mining is more difficult. A potential resource is gravel.—M.C.M.

1688 **Barr, David I. H.** Turbulent flow in porous media [discussion of paper 4019 by J. C. Ward, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 323-325, 1965.

An alternative approach to obtaining the basic parameters for flow through porous media is outlined.—E.S.L.

1689 **Barr, David I. H.** Geometrical properties of sand waves [discussion of paper 4055 by M. S. Yalin, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 343-347, 1965.

The writer believes certain aspects of the commonly adopted nomenclature can lead to lack of understanding of the significance of the groups. In particular, the Reynolds and Froud numbers and dynamic velocities are discussed.—E.S.L.

Barrington, Alfred E. *See* Poschenrieder, Walter P. 2011

1824 **Barth, T. F. W.** Memorial to Pentti Eskola (1883-1964): Geol. Soc. America Bull., v. 76, no. 9, p. P117-P120, portrait, 1965.

1552 **Bateman, Paul C.** Geology and tungsten mineralization of the Bishop district, California: U.S. Geol. Survey Prof. Paper 470, 208 p., illus., tables, geol. maps, 1965.

The first part of the report deals with strata younger than the Sierra Nevada batholith of Paleozoic and Mesozoic age and with complex structures in these strata. The second part of the report deals with the Sierra Nevada batholith and with the genesis of the contact metasomatic tungsten deposits for which the district is well known. The last part of the report is a description of the Cenozoic deposits and of the structural and geomorphic events that produced the landscape.—W.L.G.

1982 **Bates, Robert G.; Bell, Henry, 3d.** Geophysical investigations in the Concord quadrangle, Cabarrus and Mecklenburg Counties, North Carolina: U.S. Geol. Survey Geophys. Inv. Map GP-522, scale 1:48,000, separate text, 1965.

Aeromagnetic survey of the Concord quadrangle was flown at 500 feet above ground; contour intervals are 20, 100, and 500 gammas. Most of the quadrangle is in the Charlotte belt of the Piedmont; rocks are gneiss and schist (most widespread), granites, gabbro, syenite, and diabase dikes. The largest magnetic anomalies (of the order of 3,000 γ) are associated with the gabbro-syenite complex and outline it closely. Higher-than-average radioactivity was observed over the two large syenite bodies of the complex. Geophysical data aided in interpretation of structure, separated rock units difficult to distinguish in the field, and outlined a previously unknown rock unit—a granite body underlying the town of Concord.—M.C.M.

Bath, M. *See* Hodgson, J. H. 2123

Baver, L. D., Jr. *See* Moberly, Ralph, Jr. 1784

1707 **Beal, Laurence H.; Jerome, S. E.; Schilling, John H.** Geology of Area B, including trenched area, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 36-39, App. p. 91-117, illus., geol. map, 1964 [1965].

Area B Ground-Zero is the Project Shoal test site in the Sand Springs Range. The principal country rock is the Cretaceous granitic core of the range which, in this area, has a variety of joints and faults in northeast-trending patterns cut by aplite-pegmatite dikes. Two diamond drill holes test ground conditions in depth. Although alteration is common along joints, fracture cleavages, and faults, rock only a few inches from the structure usually is fresh, solid, and dense. Rock in major fault zones is highly altered.—M.C.

1788 **Beall, John V.** Southwest copper—A position survey: Mining Eng., v. 17, no. 10, p. 77-92, illus., tables, 1965.

A brief description is given of the scope of operations and expansion plans of the 17 operating mines in the Southwest. The area covered is Arizona and Chino, N. M., and Cananea, Sonora, Mexico. Operating data for each property are given in a complete table. There is a discussion of the dump leaching process and a table of some operating data. The article is accompanied by four pages of color photographs.—Mining Eng. abstract

2014 **Beaumont, E. C.; Dixon, G. H.** Geology of the Kayenta and Chilchinbito quadrangles, Navajo County, Arizona: U.S. Geol. Survey Bull. 1202-A, p. A1-A28, illus., table, geol. map, 1965.

Approximately 4,600 feet of Triassic, Jurassic, and Cretaceous sedimentary rocks are exposed in the Kayenta and Chilchinbito 15-minute quadrangles in northern Navajo County, Ariz. Formations described include the Triassic Chinle Formation; Triassic-Jurassic Glen Canyon Group; Jurassic San Rafael Group, Cow Springs Sandstone, and Morrison Formation; and Cretaceous Dakota Sandstone, Mancos Shale, and Mesaverde Group. Four areas of Tertiary intrusives are present. Possible reserves of oil and gas may occur in Paleozoic rocks, and coal has been mined from the Wepo Formation. Structurally the greater part of the area lies on the north margin of Black Mesa basin, a depression in the southern Colorado Plateau province.—V.S.N.

Bell, Henry, 3d. *See* Bates, Robert G. 1982

Benedict, J. B. *See* Outcalt, S. I. 1813

Berg, H. C. *See* Lathram, E. H. 1566

Berger, K. C. *See* Stewart, J. A. 1818

2034 **Berkner, L. V.; Marshall, L. C.** History of major atmospheric components, *in* Symposium on the evolution of the Earth's atmosphere: Natl. Acad. Sci. Proc., v. 53, no. 6, p. 1215-1226, illus., 1965.

The authors postulate the initial premise that the Earth accumulated without an external primordial atmospre. This leads to the view that the atmosphere is of secondary internal origin. Oxygen was largely absent from the primitive secondary atmosphere. Production of oxygen and the ozone by photodissociation of H_2O by solar ultraviolet radiation and the resulting formation of crustal oxides due to atmosphere contact with the Earth, are discussed. Estimates of oxygenic concentration in the several ages are summarized in a graphic model.—E.S.L.

1921 **Berry, Frederick A. F.** Origin of nitrogen–methane gas and anomalously high fluid pressures, Sacramento Valley, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1757, 1965.

Beverage, J. P. *See* Hale, W. E. 1559

1744 **Biederman, E. W., Jr.** Crude oil composition—A clue to migration: World Oil, v. 161, no. 7, p. 78–82, illus., 1965.

Statistical comparisons of API gravities, of chemical compositions, of viscosities, and of sulfur content and viscosities of shallow and deep and young and old crude oils are made. API gravity increases with both depth of burial and age; crude oils evolve with age and depth of burial toward normal paraffins with fewer carbon atoms per molecule. Sulfur content decreases as distance of migration increases. In most cases viscosity and sulfur content decrease with increasing age and depth of burial. Data are presented in tables and graphs.—M.W.R.

1766 **Birch, Francis.** Energetics of core formation: Jour. Geophys. Research, v. 70, no. 24, p. 6217–6221, tables, 1965.

The loss of gravitational energy on core formation is calculated for the case of simple unmixing of two components, whose equations of state are found from the present density distribution. Without allowance for thermal expansion, the mean energy available for heating is 600 cal per g; with an approximate allowance for thermal expansion, this is reduced to 400 cal per g, which is equivalent to a mean rise of temperature of about 1,600°. The moment of inertia of the undifferentiated Earth is found to be about 10 percent greater than that of the present state, for the spherical model.—Author's abstract

2109 **Birkelund, Tove.** Ammonites from the Upper Cretaceous of West Greenland [with Danish abs.]: Medd. om Gronland, v. 179, no. 7, 192 p., illus., tables, 1965.

Ammonites from Nugssuaq and Svartenhuk are described. *Baculites* and *Scaphites* are richly represented, and the material provides a basis for evaluating the subgenera *Hoploscaphites* and *Discoscaphites*. The ontogeny and phylogeny of most genera are discussed and juvenile stages of *Saghalinites* and *Scaphites* are described. Eleven new species and three new subspecies are introduced. The stratigraphic, paleogeographic, and paleoecologic aspects of the assemblages are considered, and the presence of 12 biozones is demonstrated. The ammonites, with belemnites and inoceramids, show that the area was connected with the interior of North America and also with Europe by a seaway during parts of the Upper Cretaceous.—E.S.L.

1869 **Black, Bruce A.** Geology of the northern and eastern portions of the Ladron Mountains, Socorro County, New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 185–186, 1964.

Blake, W., Jr. *See* Dyck, W. 1740

Block, Barry. *See* Weiss, Rainer. 1570

1737 **Bloomer, Robert O.** Precambrian Grenville or Paleozoic quartzite in the Dekalb area in northern New York: Geol. Soc. America Bull., v. 76, no. 9, p. 1015–1026, illus., 1965.

Enigmatic bodies of quartzite in marble of the Precambrian Grenville complex in northern New York are considered as part of the complex and not outliers of Paleozoic formations—a view held for the last 50 years. Evidence of Precambrian age are areal relations, dissimilarity in thickness and lithology to nearby Paleozoic quartzites, structural concordance with enclosing marble, and metamorphic grade. Conglomerates in quartzites contain clasts indicative of a pre-Grenville metamorphic cycle.—R.G.Y.

1775 **Bluck, Brian J.** Sedimentation of Middle Devonian carbonates, southeastern Indiana: Jour. Sed. Petrology, v. 35, no. 3, p. 656–682, illus., 1965.

Seven microfacies representing lacustrine, mudflat, lagoonal, and off-shore environments are recognized. Algae are common in the lacustrine and mudflat environments, brachiopods are in the lagoonal environment, and calcarenites with an abundant fauna are assigned to an off-shore environment. Microfacies are recognized by grain size, rock color, dolomitization, and fabric.—G.O.B.

1922 **Blue, Donald M.** Reflection techniques suggest nature of deep-ocean sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1757, 1965.

1758 **Blumer, Max; Snyder, W. Dale.** Isoprenoid hydrocarbons in recent sediments—Presence of pristane and probable absence of phytane: Science, v. 150, no. 3703, p. 1588–1589, tables, 1965.

Pristane (2, 6, 10, 14-tetramethylpentadecane) has been isolated from two recent marine sediments. Unlike their ancient counterparts, these sediments contain no detectable phytane. These two facts suggest a biochemical origin for at least a fraction of the sedimentary pristane and a later, geochemical formation of phytane. Commercial reagent-grade solvents (petane, isoctane, methanol) contain appreciable quantities of fossil pristane and probably phytane.—Authors' abstract

1842 **Boelter, D. H.** Hydraulic conductivity of peats: Soil Sci., v. 100, no. 4, p. 227–231, 1965.

The field-measured hydraulic conductivities of peat were lower than laboratory measurements. There is no significant difference between vertical and horizontal hydraulic conductivity. Undecomposed moss peats have specific yields of 0.52 to 0.79 cc/cc and allow rapid water movement, having hydraulic conductivities of more than 3810×10^{-5} cm/sec. Woody peats have specific yields of 0.19 to 0.33 cc/cc and hydraulic conductivity rates of 55.8 to 104×10^{-5} cm/sec. The decomposed and herbaceous peats permit little water movement, have specific yields of only 0.10 to 0.15 cc/cc, and hydraulic conductivity rates as low as 0.75×10^{-5} cm/sec.—J.W.H.

1997 **Bolt, Bruce A.** Seismological investigations in California, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 21–26 [1965].

The history of seismology in the State is given starting with 1887 when instrumental measurements of earthquakes were begun at Lick Observatory, and ending with current research involving three large networks of stations.—E.S.L.

2001 **Bonilla, M. G.** U.S. Geological Survey engineering geology investigations in California, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 47–53, illus. [1965].

The Survey's program is largely one of geologic mapping in urban areas, for the purpose of gaining knowledge of the geology which can be used to minimize the problems in areas of rapid growth. The Los Angeles and San Francisco Bay projects are discussed, and some of the 30 geological projects are shown on a map which also shows the major faults.—E.S.L.

Bonno, M. *See* Danes, Z. F. 1750

2072 **Borns, Harold W., Jr.; Goldthwait, Richard P.** Late Pleistocene fluctuations of Kaskawulsh Glacier, Yukon Territory [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 606, 1965.

1923 **Brabb, Earl E.** Stratigraphy and oil possibilities of Mesozoic rocks in Kandik basin, east-central Alaska [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1757–1758, 1965.

Brace, W. F. *See* Simmons, Gene, 1569

1580 **Brace, W. F.; Orange, A. S.; Madden, T. R.** The effect of pressure on the electrical resistivity of water-saturated crystalline rocks: Jour. Geophys. Research, v. 70, no. 22, p. 5669–5698, illus., tables, 1965.

Electrical resistivity was measured at pressures to 10 kb on 8 igneous rocks and 2 crystalline limestones saturated with tap water or salt solution, with pore pressure maintained near zero. Dependence of resistivity on temperature, porosity, and pore fluid salinity suggested that conduction was primarily electrolytic. Resistivity increased with increasing pressure. Data suggest that electrical conductivity of these rocks consist of conduction along cracks, at pressures below a few kb, and volume and surface conduction along a network of pores, throughout the entire pressure range. Surface conduction of rocks saturated with tap water was 10–20 times greater than volume conduction of pores. Dependence of conductivity on porosity for all samples saturated with saline solutions follows the same empirical law observed for porous sedimentary rocks.—D.B.V.

1581 **Brace, W. F.** Relation of elastic properties of rocks to fabric: Jour. Geophys. Research, v. 70, no. 22, p. 5657–5667, illus., tables, 1965.

Variation of linear compressibility in ten rocks was compared with preferred orientation of mica, calcite, or quartz. Actual variation, measured at a confining pressure of 3 kb, was in close agreement with the variation calculated from preferred orientation, modal analyses, and mineral properties for rocks which ranged from poorly oriented quartzite to slate. Measurement of thermal expansion and thermal conductivity for one of the rocks, Yule marble, gave values in close agreement with those predicted from the fabric.—Author's abstract

1811 **Bradford, G. R.; Pratt, P. F.; Bair, F. L.; Goulben, B.** Separation and determination of total Al, Mg, Ni, Mn, Co, Cu, Fe, Mo, and Zn in soils: Soil Sci., v. 100, no. 5, p. 309–318, illus., 1965.

Standardized colorimetric methods are used to determine each element; detailed information is given on the procedure. With the exception of Fe and Mn, the method generally gives better than ±15 percent recovery of added trace elements, and results permit the characterization of soils, including the deficiency status with respect to total content of the elements determined.—J.W.H.

1794 **Bradley, W. H.** Vertical density currents: Science, v. 150, no. 3702, p. 1423–1428, illus., 1965.

Diatom frustules and calcite particles formed in eutropic lakes are settled to the bottom much faster than predicted by Stoke's law. Experimental evidence indicates this rapid settling results from vertical density currents set up as closely packed particles and the water containing them become heavier per unit volume than surrounding volumes of sediment-poorer water.—F.W.C.

1701 **Branson, Carl C.; Huffman, George G.; Strong, Daniel M.** (and others) Geology and oil and gas resources of Craig County, Oklahoma: Oklahoma Geol. Survey Bull. 99, 109 p., illus., geol. map, 1965.

In this area northwest of the Ozark uplift, sedimentary strata dip gently westward as part of the Prairie Plains homocline. Rocks exposed range in age from Late Devonian to Middle Pennsylvanian, with a disconformity at the Late Mississippian–Early Pennsylvanian boundary. Subsurface formations are correlated with the exposed rocks, and the stratigraphy detailed by measured sections. Two new names proposed for sandstone units are Dickson Sandstone Member of the Savanna Formation, and Goldenrod Sandstone Member of the Senora Formation. The regional dip is interrupted locally by folding and normal faulting, the principle named features of which are described. Coal, oil and gas, and stone are the products, with limited future oil and gas possibilities.—G.D.C.

Brau, E. *See* Danes, Z. F. 1750

1562 **Brazee, Rutlage J.** A study of T phases in the Aleutian earthquake series of March and April 1957: Earthquake Notes, v. 36, nos. 1–2, p. 9–14, illus., 1965.

When the Honolulu seismograms were read for the period from March 9 through April 31, 1957, it was found that the HTL vertical seismometer was extremely efficient for recording "T" waves. They were recorded for 55 of the 204 Aleutian

earthquakes located in that period, and compared with others. This study lends support to previous ideas that magnitude alone is not the determining factor in T generation or amplitude, that conversion from P may be made at any point along the path where a suitable interface occurs and more efficiently where there is contact between the axis of the slow speed layer and the bottom than in open water.—G.D.C.

1989 **Brewer, James C.** The genus, *Steganocrinus*: Jour. Paleontology, v. 39, no. 5, p. 773–793, illus., 1965.

The Mississippian (Osage) camerate crinoid *Steganocrinus* is divided into three species-groups on the basis of material from the Lake Valley Limestone, New Mexico, the Fern Glen Limestone, Missouri, and the Burlington Limestone, Missouri and Iowa. *S. araneolus* (Meek and Warthen) is a growth variant of *S. pentagonus* (Hall). Six new species are *S. altus, S. longus, S. multistriatus, S. robustus, S. planus*, and *S. burlingtonensis*. Synonymies of species previously assigned to the genus are included.—R.E.G.

2041 **Bricker, Owen.** Some stability relations in the system $Mn–O_2–H_2O$ at 25° and one atmosphere total pressure: Am. Mineralogist, v. 50, no. 9, p. 1296–1354, illus., tables, 1965.

Stability relations in the system $Mn–O_2–H_2O$ were studied at 25°C and 1 atm total pressure. $Mn(OH)_2$ (pyrochroite), Mn_3O_4 (hausmannite), γ–Mn_2O_3, γ–MnOOH (manganite), δ–MnO_2 (birnessite), γ–MnO_2 (nsutite), and hydrohausmannite were synthesized under controlled Eh and pH; hydrohausmannite is a mixture of Mn_3O_4 and/or γ–Mn_2O_3 and β–MnOOH. Free energy of formation for the first six compounds listed are respectively –147.14, –306.2, –132.2, –133.3, –108.3, –109.1, in Kcal. The name feitknechtite is proposed for natural β–MnOOH. Eh–pH diagrams showing the stability relations of these phases demonstrate good correspondence between laboratory and natural mineral assemblages.—E.Z.

2110 **Bridgwater, David.** Isotopic age determinations from South Greenland and their geological setting: Medd. om Grønland, v. 179, no. 4, 56 p., illus., tables, geol. map, 1965.

It is suggested that the pre–Ketilidian gneisses represent the remnant of an old fold belt formed about 2400–2700 m.y. ago, and that the Ketilidian, post Ketilidian, and Sanerutian episodes are phases in the evolution of one belt. The Gardar magmatism, at about 1200 m.y., is regarded as typical post–orogenic, and may represent compensatory tension on the edge of the Grenville fold belt which probably passed south of Greenland. Eight K–Ar and four Rb–Sr ages are given. It is suggested that most of the south–west coastal strip is pre–Ketilidian, and that the Nagssugtoqidian and Ketilidian–Sanerutian fold belts formed at approximately the same time. These episodes are compared with those in the Canadian Shield.—E.S.L.

1894 **Brindle, J. E.; Guliov, Paul.** Fossils from the Upper Devonian Big Valley Formation in western Saskatchewan: Bull. Canadian Petroleum Geology, v. 13, no. 2, p. 238–251, illus., 1965.

Brachiopods and pelecypods [!cephalopods] collected from cores taken in three wells in western Saskatchewan are evidence for correlation of the Upper Devonian Big Valley Formation with formations in Alberta (upper Palliser, Boule), Montana (upper Three Forks), Idaho (Three Forks in part), Colorado (Ouray in part) and New Mexico (Percha in part).—Authors' abstract

1588 **Brindley, G. W.** Introduction to Section 1—Clay mineral structures and compositions, *in* Internat. Clay Conf., Stockholm, 1963, Proc., V. 2: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 21), p. 7–8, 1965.

Looking back over 30 years of research on clay mineral structures, three well–defined stages can be defined. The first was concerned with principles of clay mineral structures, the second with recognition of structural varieties, and the third with more detailed structural analysis. The papers in this section of the International Clay Conference give results of more recent research, by foreign authors.—G.D.C.

2033 **Brindley, G. W.; Moll, W. F., Jr.** Complexes of natural and synthetic Ca montmorillonites with fatty acids (clay–organic studies–IX): Am. Mineralogist, v. 50, no. 9, p. 1355–1370, illus., tables, 1965.

Short–spacing complex (d(001)< 17A) are formed with fatty acids up to and including C–9, and long–spacing complexes (d(001)>20A) with acids from C–10 to C–18. Single layers of molecules standing at about 65°±6° to (001) apparently are formed between the silicate sheets. If the molecules are attached equally to all silicate surfaces by active OH groups, packing considerations suggest a "head–to–tail" arrangement in pairs with some lengthwise displacement due to the bulky COOH terminations. The observed angle of tilt is consistent with a considerable degree of close–packing of the chain molecules, and also with possible close–packing between terminal OH groups and the silicate oxygen surfaces.—E.Z.

1987 **Brown, George D., Jr.** Trepostomatous Bryozoa from the Logana and Jessamine limestones (Middle Ordovician) of the Kentucky bluegrass region: Jour. Paleontology, v. 39, no. 5, p. 974–1006, illus., 1965.

Of twenty species identified, fifteen occur in the same units elsewhere. Six new species, *Amplexopora minor, Cyphotrypa pachymuralis, Dekayella anomala, Lamottopora pauca, Stigmatella conica*, and *S. multispinosa* are described. Four species, *Cyphotrypa acervulosa* (Ulrich), *Dekayella clavata* Fritz, *Hemiphragma tenuimurale* Ulrich and *Homotrypella mundula* Ulrich suggest a Trenton age for the two formations. Other characteristic species are *Eridotrypa aedilis* (Eichwald), *Hallopora multitabulata* (Ulrich) and *Prasopora falesi* (James). *Prasopora simulatrix* Ulrich is neither as structurally distinct nor as abundant in the Jessamine as previously thought.—R.E.G.

1675 **Brown, Noel K., Jr.** Stratigraphy of Upper Cretaceous beds in the vicinity of D'Hanis, Medina County, Texas, *in* Upper Cretaceous asphalt deposits of the Rio Grande embayment—Corpus Christi Geol. Soc., Ann. Field Trip 1965: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 23–30, illus., 1965.

In this small area on the northern edge of the Rio Grande embayment, the Campanian and Maestrichtian beds are of considerable economic value. Faults of the Balcones system have locally reversed the regional dip of these beds and formed a graben and a horst. The writer's interpretation of the stratigraphic relationships of these beds is shown in a correlation chart, and measured sections of four localities are given in the itinerary of the guidebook. The faunal assemblages are noted, particularly the foraminiferal changes, for which a chart shows species range in the Anacacho, Corsicana, and Escondido Formations in Seco Creek.—G.D.C.

1979 **Bruer, Wesley G.** Edison oil field, *in* Geology of the southeastern San Joaquin Valley, California—AAPG, SEG, and SEPM, Pacific Secs., Guidebook 1965: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 17–19, 1965.

This 6,880 acre field has produced to date over 97 million bbl of oil and 57.5 million cubic feet of gas. The structure of the six main areas within the field are described briefly and the production of each listed.—E.S.L.

1900 **Bryant, Leonard C.** South Copano Bay Field, Aransas County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1748–1749, 1965.

Brydon, G. E. *See* Turner, R. C. 1815

1826 **Bucher, Walter H.** Memorial to Arie Poldervaart (1918–1964): Geol. Soc. America Bull., v. 76, no. 9, p. P125–P131, portrait, 1965.

1852 **Budding, A. J.** Geologic outline of the Jicarilla Mountains, Lincoln County, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 82–86, illus., 1964.

The Jicarilla Mountains are an extension of the Sacramento Mountains and the Sierra Blanca. Permian to Pliocene stratigraphy, petrology of the igneous rocks,

structural and igneous evolution, and mineral deposits are discussed. A geologic sketch map and section are included.—E.S.L.

Bugh, James E. *See* Dodd, J. Robert. 1785

Buhsmer, Charles P. *See* Roy, Rustum. 2026

Bull, Colin. *See* Anderton, Peter W. 2071

1916 **Burdine, E. D.; Paine, W. R.; Wire, J. C.** Environmental observations in Grande Isle–Grande Terre area of south Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1755, 1965.

1849 **Burton, Robert C.** A preliminary range chart of Lake Valley Formation (Osage) conodonts in the southern Sacramento Mountains, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc. 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 73–75, illus., 1964.

Five localities associated with bioherms in the Alamo Canyon area were sampled, 1/2 kilogram chips being taken from one ft intervals. The 450 samples taken produced 4,200 specimens. Some stratigraphic implications of several species are discussed and a chart illustrates their stratigraphic ranges.—E.S.L.

1870 **Burton, Robert C.** Conodonts from the southern Sacramento Mountains, Otero County, New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 186, 1964.

2029 **Butler, James Robert.** Guide to the geology of York County, South Carolina—Carolina Geological Society field trip, October 23–24, 1965: South Carolina Devel. Board Div. Geology Geol. Notes, v. 9, no. 2, p. 27–36, illus., 1965.

Besides a road log with rather detailed descriptions of geology at the stops, the guide includes discussion of the Carolina Slate, Charlotte and Kings Mountain belts, and a geologic sketch map of the County.—E.S.L.

1996 **Byerly, Perry.** California's earthquake history, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 16–20 [1965].

The author gives an informal review of all the larger earthquakes in California, beginning with 1812. Reports of the damage are given, along with movement on the fault which caused it. Most of them involve the Hayward and San Andreas faults.—E.S.L.

1924 **Byrne, John V.; Maloney, Neil J.** Offshore Oregon—Observations on regional geology [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1758, 1965.

Byrne, John V. *See* Maloney, Neil J. 1949

Cain, J. Allan. *See* Dodd, J. Robert. 1785

1756 **California Dept. Water Resources.** Crustal strain and fault movement investigation—Faults and earthquake epicenters in California: California Dept. Water Resources Bull. 116–2, 96 p., tables, 1964.

This report, second in a series, brings together on a statewide basis a comprehensive compilation of data on location of faults and earthquake epicenters for use in the development of aseismic design criteria for hydraulic structures. Divided into three parts, the first presents a tabulation of data on all earthquakes, Richter magnitude 4 and greater, which occurred in California and adjacent areas from 1934 through 1961. Part 2 is a bibliography of significant references used in compiling the earthquake epicenter and fault map, and part 3 is the map, presented in three sections along with an index map of major sources of geologic data.—G.D.C.

1925 **Calvert, S. E.** Accumulation of diatomaceous silica in sediments of Gulf of California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1758, 1965.

1963 **Campbell, A. S.; Fyfe, W. S.** Analcime–albite equilibria: Am. Jour. Sci., v. 263, no. 9, p. 807–816, illus., table, 1965.

New data are presented that suggest the reaction analcime+quartz=albite+liquid water is in equilibrium near 190°C or possibly at even lower temperatures. On the basis of these data, a phase diagram showing the field of stability of the assemblage analcime–quartz is constructed. The $\Delta G°$ of the above reaction estimated from these data is 330 calories, and factors that may influence equilibria such as salinity, silica activity, solid solutions, and order–disorder are considered. Experimental difficulties associated with studies of zeolite equilibria are considered in the light of entropy data.—Authors' abstract

Campbell, Arthur B. *See* Hobbs, S. Warren. 2045

Campbell, F. A. *See* Maiklein, W. R. 1810

1914 **Campbell, Francis F.** Fault criteria [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1755, 1965.

2002 **Campbell, Ian.** Program of the Division of Mines and Geology, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 68–72 [1965].

The history of the Division is reviewed briefly, and the changes in knowledge of the State's geology are described. Early emphasis on metallic minerals has shifted to industrial. All the information acquired is of use in working on geologic hazards.—E.S.L.

1598 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3133, scale 1:63,360, 1965.

1599 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3135, scale 1:63,360, 1965.

1600 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/1, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3136, scale 1:63,360, 1965.

1601 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3137, scale 1:63,360, 1965.

1602 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3138, scale 1:63,360, 1965.

1603 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3139, scale 1:63,360, 1965.

1604 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/1, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3140, scale 1:63,360, 1965.

1605 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3141, scale 1:63,360, 1965.

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1606 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3142, scale 1:63,360, 1965.

1607 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3143, scale 1:63,360, 1965.

1608 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/1, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3144, scale 1:63,360, 1965.

1609 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3145, scale 1:63,360, 1965.

1610 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3146, scale 1:63,360, 1965.

1611 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3147, scale 1:63,360, 1965.

1612 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3148, scale 1:63,360, 1965.

1613 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/6, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3149, scale 1:63,360, 1965.

1614 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3150, scale 1:63,360, 1965.

1615 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3151, scale 1:63,360, 1965.

1616 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3152, scale 1:63,360, 1965.

1617 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/6, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3153, scale 1:63,360, 1965.

1618 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3154, scale 1:63,360, 1965.

1619 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3155, scale 1:63,360, 1965.

1620 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3156, scale 1:63,360, 1965.

1621 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/6, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3157, scale 1:63,360, 1965.

1622 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3158, scale 1:63,360, 1965.

1623 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3159, scale 1:63,360, 1965.

1624 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3160, scale 1:63,360, 1965.

1625 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/6, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3161, scale 1:63,360, 1965.

1626 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3162, scale 1:63,360, 1965.

1627 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3163, scale 1:63,360, 1965.

1628 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/11, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3164, scale 1:63,360, 1965.

1629 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3165, scale 1:63,360, 1965.

1630 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/9, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3166, scale 1:63,360, 1965.

1631 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3167, scale 1:63,360, 1965.

1632 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/11, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3168, scale 1:63,360, 1965.

1633 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3169, scale 1:63,360, 1965.

1634 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/9, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3170, scale 1:63,360, 1965.

1635 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3171, scale 1:63,360, 1965.

1636 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/11, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3172, scale 1:63,360, 1965.

1637 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3173, scale 1:63,360, 1965.

1638 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/9, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3174, scale 1:63,360, 1965.

1639 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3175, scale 1:63,360, 1965.

1640 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/11, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3176, scale 1:63,360, 1965.

1641 **Canada Geological Survey.** Aeromagnetic map, Sheet 55D/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3177, scale 1:63,360, 1965.

1642 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/13, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3178, scale 1:63,360, 1965.

1643 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/14, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3179, scale 1:63,360, 1965.

1644 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/15, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3180, scale 1:63,360, 1965.

1645 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/16, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3181, scale 1:63,360, 1965.

1646 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/13, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3182, scale 1:63,360, 1965.

1647 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/14, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3183, scale 1:63,360, 1965.

1648 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/15, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3184, scale 1:63,360, 1965.

1649 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 B/16, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3185, scale 1:63,360, 1965.

1650 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/13, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3186, scale 1:63,360, 1965.

1651 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/14, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3187, scale 1:63,360, 1965.

1652 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/15, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3188, scale 1:63,360, 1965.

1653 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 A/16, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3189, scale 1:63,360, 1965.

1654 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/13, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3190, scale 1:63,360, 1965.

1655 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/14, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3191, scale 1:63,360, 1965.

1656 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 D/15, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3192, scale 1:63,360, 1965.

1681 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 N/1, Manitoba: Canada Geol. Survey Geophys. Paper 2559, scale 1:63,360, 1965.

1682 **Canada Geological Survey.** Aeromagnetic map, Duval Lake, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2547, scale 1:63,360, 1965.

2086 **Carlson, C. G.; Anderson, S. B.** Sedimentary and tectonic history of North Dakota part of Williston basin: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1833–1846, illus., 1965.

The Williston basin is an intracratonic structural and sedimentary basin which includes 51,600 sq mi in North Dakota. It contains sedimentary rocks of every geologic period from Cambrian through Tertiary and the maximum known thickness is 15,128 feet in a well in McKenzie County in western North Dakota. The authors briefly describe the depositional history of the stratigraphic sequence.—A.E.R.

Carpenter, Carl H. *See* Young, Richard A. 1591

1832 **Carter, D. L.; Heilman, M. D.; Gonzalez, C. L.** Ethylene glycol monoethyl ether for determining surface area of silicate minerals: Soil Sci., v. 100, no. 5, p. 356–360, illus., 1965.

Ethylene glycol monoethyl ether is a useful adsorbate for determining the surface area of layer silicate minerals. The surface area of dry montmorillonite can be determined in less than a day compared to more than 20 days when ethylene glycol is used as the adsorbate. Both compounds precisely measure the same surface area, and they are probably influenced similarly by the saturating cations.—J.W.H.

1821 **Carter, Neville L.** Basal quartz deformation lamellae—A criterion for recognition of impactites: Am. Jour. Sci., v. 263, no. 9, p. 786–806, illus., 1965.

Quartz deformation lamellae parallel to the basal (0001) plane, identical to lamellae produced experimentally at ordinary laboratory strain rates, occur to the exclusion of lamellae of other orientations in specimens from six cryptoexplosive structures, including the Vredefort Ring, South Africa, Barringer Crater, Arizona, and Clearwater Lakes, Quebec. The basal lamellae are randomly oriented in space and are significantly different in character and crystallographic orientation from lamellae of all other natural occurrences. Available data indicate that the shear stress differences required to produce the basal lamellae could easily result from shock due to impact of an extraterrestrial body but could not reasonably result from natural explosions generated within the Earth.—H.R.C.

1822 **Carter, Neville L.; Friedman, Melvin.** Dynamic analysis of deformed quartz and calcite from the Dry Creek Ridge anticline, Montana: Am. Jour. Sci., v. 263, no. 9, p. 747–785, illus., 1965.

Dynamic analyses of deformed quartz and calcite from the Swift Formation at Dry Creek Ridge anticline, Montana, were made to test the method for determining orientations of principal stress directions from microstructures produced by intragranular flow in quartz and the homogeneity of principal stress orientations around a fold. Close correspondence of results with Turner's (1953) calcite technique indicates that quartz may be used independently for dynamic analysis. Arguments presented suggest that under the ambient conditions of deformation (about 1 kb

overburden pressure, 100° to 150°C), the stress difference of slip in quartz was probably as low as that for deformation of the calcite aggregate. Orientations of deduced principal stress axes around the fold are remarkably consistent. In consideration of regional structure, the orientations of principal stress directions probably reflect bending stresses in the compressive part of a very thick plate.—R.K.H.

2091 **Carter, W. D.; Gualtieri, J. L.** Geyser Creek Fanglomerate (Tertiary), La Sal Mountains, eastern Utah: U.S. Geol. Survey Bull. 1224-E, p. E1-E11, illus., 1965.

The Gevser Creek Fanglomerate, a name here applied to an extensive conglomerate deposit of Tertiary age, crops out within the Taylor Creek syncline on the southeast flank of the North Mountain group of the La Sal Mountains. . . . The formation unconformably overlies the Mancos Shale of Late Cretaceous age and is unconformably overlain by the Hapole Mesa Formation of early Quaternary age. Tilting of the beds and angular unconformities, which mark the upper and lower contacts, indicate that the Fanglomerate was folded prior to glaciation in the mountains. The Fanglomerate is considered to be of probable Pliocene age and correlative with a similar conglomerate in Castle Valley.—Authors' abstract

2102 **Casagrande, Arthur; Rutledge, Philip C.; Watson, John D.** (editors) Proceedings of the international conference on soil mechanics and foundation engineering, June 22 to 26, 1936: Cambridge, Mass., Harvard Univ., Graduate School Eng., V. 1, 336 p.; V. 2, 318 p.; V. 3, 268 p., illus., tables, reprinted 1965; originally published 1936.

These proceedings of the first international conference on soil mechanics and foundation engineering have been reprinted with corrections. The volumes contain numerous papers by North American and foreign authors on soils, soil properties, foundations, ground-water movement, and engineering problems.—M.C.M.

Cheney, T. M. *See* Roberts, Ralph J. 2051

2058 **Christensen, M. N.** Late Cenozoic deformation in the central Coast Ranges of California: Geol. Soc. America Bull., v. 76, no. 10, p. 1105-1124, illus., tables, 1965.

Crustal movements in the central Coast Ranges during the last 2 or 3 million years are determined by Pliocene-Pleistocene stratigraphy, structures, and physiography. Major block boundaries are independent of the course of the San Andreas fault. Vertical movements of major blocks are probably mechanically independent of strike-slip movements on major faults, but may be related to intrusion of magma at depth.—A.G.

1760 **Christensen, Nikolas I.** Compressional wave velocities in metamorphic rocks at pressures to 10 kilobars: Jour. Geophys. Research, v. 70, no. 24, p. 6147-6164, illus., tables, 1965.

Compressional wave velocities have been measured at 100-10,000 bars pressure on various metamorphic rocks believed to be important constituents of the Earth's crust. Principal factors contributing to compressional wave velocities in igneous and metamorphic rocks are discussed, with particular attention to dependence of velocity on porosity, mineral orientation, and mineral composition. It is found that initial changes in velocity with pressure are related to the arrangement and shape of pore spaces in a rock; that variation of velocity with propagation direction in metamorphic rocks is a consequence of preferred mineral orientation; and that velocities calculated from single-crystal data agree with most of the measured velocities.—D.B.V.

1728 **Christman, Robert A.** A relief model for teaching topographic contours: Jour. Geol. Education, v. 13, no. 4, p. 113-114, illus., 1965.

The model was built to develop an exercise in which the student collects the data, as he might do in the field, and draws a contour map which can be checked against the topography of the area mapped. The relief model was built inside a box with

a movable cross beam on top with holes drilled so that a calibrated measuring rod could be lowered to get elevations at marked locations on the relief model.—E.S.L.

1883 **Clark, D. L.; Ethington, R. L.** Conodont biostratigraphy of part of the Devonian of the Alberta Rocky Mountains: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 382–388, 1965.

Significant conodont faunas were found in the Devonian Flume, Perdrix, and Mt. Hawk Formations at Cold Sulphur Springs, north of Jasper, Alberta. They suggest that all but the upper few feet of the Flume is of late Middle Devonian (Givetian) age, that the uppermost part of the Flume, the Perdrix, and lower part of the Mt. Hawk are of early Late Devonian (Frasnian) age, and that the upper part of the Mt. Hawk is of latest Devonian (early Famennian) age.—C.A.S.

1871 **Clark, Kenneth F.** Hypogene zoning in the Lordsburg mining district, Hidalgo County, New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 186–187, 1964.

Cobban, William A. *See* Scott, Glen R. 2106

2042 **Collins, L. B.; Hagner, A. F.** Refractive index field diagrams and mineral relationships for coexisting ferromagnesian silicates: Am. Mineralogist, v. 50, no. 9, p. 1381–1409, illus., 1965.

Over 1600 refractive indices of coexisting ferromagnesian silicates have been used to construct field diagrams by plotting γ of one mineral against that of another. Fields for 2, 3, 4, 5, and 6 coexisting minerals are outlined for definite ranges of indices of each mineral. A separation of igneous and metamorphic rock types is apparent for minerals plotting in the low index range. This appears to bear out the occurrence of a partitioning of Mg and Fe atoms between coexisting ferromagnesian phases and to support the conclusion that the partitioning is a function of the conditions of formation.—Authors' abstract

1679 **Colvin, John M., Jr.; Fullerton, Donald S.** Mineral resources summary of the Charlotte quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 9 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 48-NE and describes the iron ore and limestone resources of the Charlotte quadrangle. Iron ore deposits occur near the central and east-central parts of the area on or near crests and spurs of ridges which are generally covered with a thick mantle of weathered Mississippian residuum overlain by gravel, sand, and clay of the Tuscaloosa Formation. The Warsaw Limestone, most available and acceptable for general purposes, has been quarried at four sites; the St. Louis Limestone contains some beds that could be quarried in the eastern part of the quadrangle. None of the 11 test wells drilled for oil and gas resulted in commercial production.—M.C.M.

2016 **Commoner, Barry.** Biochemical, biological, and atmospheric evolution, *in* Symposium on the evolution of the Earth's atmosphere: Natl. Acad. Sci. Proc., v. 53, no. 6, p. 1183–1194, illus., 1965.

There is a close mutual interaction between the evolution of the atmosphere and the early evolution of life. This paper is intended to analyze this interaction relative to its least understood sector—the emergence of the first living systems from the primitive environment. A tentative order of evolutionary events is proposed: stage 1, anaerobic metabolism; stage 2, unspecific polymer synthesis (growth); stage 3, organized multimolecular structure; stage 4, precise polymer synthesis (replication); and stage 5, aerobic metabolism. In each stage the indicated property is added to those appearing earlier, in keeping with the principle of epigenesis.—E.S.L.

1862 **Cooper, James B.** Water supplies near Carrizozo, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 159–160, 1964.

Ground water is relatively abundant within the alluvium in the Carrizozo area. The underlying Cretaceous beds contain sandstone aquifers under different degrees of artesian pressure. Most of the ground water is saline and contains sulfate and chlorine ions that give it an objectionable taste, but it is suitable for stock and irrigation purposes.—E.S.L.

2005 **Cotter, Edward.** Waulsortian-type carbonate banks in the Mississippian Lodgepole Formation of central Montana: Jour. Geology, v. 73, no. 6, p. 881–888, illus., 1965.

Mound-shaped banks of lithified lime mud in the Lodgepole Formation are similar to Waulsortian banks described in western Europe. The banks contain abundant fossils, principally bryozoans and crinoids.—E.T.R.

1594 **Cotter, R. D.; Young, H. L.; Petri, L. R.; Prior, C. H.** Water resources in the vicinity of municipalities on the west-central Mesabi Iron Range, northeastern Minnesota: U.S. Geol. Survey Water-Supply Paper 1759-C, p. C1–C21, illus., tables, 1965.

Additional supplies of water are available near the municipalities on the west-central Mesabi Iron Range. The largest sources are the ground-water aquifers in the Biwabik Iron-Formation and the stratified glacial drift. Areas of stratified drift that probably have good water potential have been outlined. Surface-water supplies are negligible in the eastern part of this area but increase toward the west. Flow records from one gaging station, results of discharge measurements at two miscellaneous sites, and data from many wells and test holes are presented. Most of the ground water is hard and has a high concentration of iron and manganese. The surface water generally has a high concentration of iron and is colored. Analyses of water from many sources are shown.—Authors' abstract

1703 **Cotter, R. D.; Young, H. L.; Petri, L. R.; Prior, C. H.** Water resources in the vicinity of municipalities of the central Mesabi Iron Range, northeastern Minnesota: U.S. Geol. Survey Water-Supply Paper 1759-D, p. D1–D20, illus., tables, 1965.

This report describes existing and potential ground- and surface-water supplies of Chisholm, Buhl, Kinney, Mountain Iron, and Iron Junction. The most productive aquifers are the Biwabik Iron-Formation and the stratified glacial drift. A single body of ice-contact stratified drift underlies parts of all but one of the five municipality areas mapped. Analyses of water from many sources are presented as are data from many wells and test holes.—W.L.G.

1719 **Cotter, R. D.; Young, H. L.; Petri, L. R.; Prior, C. H.** Water resources in the vicinity of municipalities on the western Mesabi Iron Range, northeastern Minnesota: U.S. Geol. Survey Water-Supply Paper 1759-B, p. B1–B24, illus., tables, 1965.

Present and potential ground- and surface-water supplies of Grand Rapids, Coleraine, Bovey, Taconite, Marble, and Calumet are described. The most productive aquifers for ground-water supplies are the Biwabik Iron-Formation and the stratified glacial drift. The most abundant surface-water supplies in the area of this report are from the Mississippi River and its tributaries. Data on two geologic sections and 18 water analyses are included.—W.L.G.

1796 **Cotter, R. D.; Young, H. L.; Petri, L. R.; Prior, C. H.** Water resources in the vicinity of municipalities on the east-central Mesabi Iron Range, northeastern Minnesota: U.S. Geol. Survey Water-Supply Paper 1759-E, p. E1–E23, illus., tables, 1965.

This report describes the existing and potential ground- and surface-water supplies on the east-central Mesabi Iron Range in the vicinity of Virginia, Eveleth, Gilbert, McKinley, and Biwabik. The most productive aquifers are the Biwabik Iron Formation and the stratified glacial drift. Potential glacial-drift sources for large ground-water supplies are outlined. Included are 7 geologic sections and 22 water analyses.—W.L.G.

1799 **Cotter, R. D.; Young, H. L.; Petri, L. R.; Prior, C. H.** Water resources in the vicinity of municipalities on the eastern Mesabi Iron Range and the Vermilion Iron Range, northeastern Minnesota: U.S. Geol. Survey Water-Supply Paper 1759-F, p. F1-F27, illus., tables, 1965.

Present and potential ground- and surface-water supplies on the eastern Mesabi and Vermilion Iron Ranges in the vicinity of Aurora, Hoyt Lakes, Babbitt, Tower-Soudan, and Cly are described in this report. Present productive aquifers are the Biwabik Iron-Formation and glacial drift; potential glacial-drift sources for large ground-water supplies are outlined. Included are 4 geologic sections and 24 water analyses.—W.L.G.

1856 **Craddock, Campbell.** The Lincoln fold system, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 122-133, illus., 1964.

In the walls of the valley of the Rio Bonito at Lincoln, the Yeso Formation contains large folds that are in startling contrast with the low dips of the formation in the surrounding region, and in the overlying San Andres Limestone. Field work shows similar crumpling over at least 3,500 sq mi. The folds are here designated the Lincoln fold system. The Yeso Formation is the oldest in the area and is conformably overlain by the San Andres Limestone. The folds are described in detail, with a three-mile cross section in the Rio Bonito Valley. Theories as to the origin of the folds are listed, and the most probable, gravity slippage on a plane in the Yeso, discussed. Tectonic maps of five areas involved are included.—E.S.L.

Crittenden, M. D., Jr. *See* Roberts, Ralph J. 2051

Cronin, John. *See* Osterberg, Charles. 1795

1685 **Crosby, Gary W.** Gravity nomographs for fault solutions: Jour. Geol. Education, v. 13, no. 4, p. 102-104, illus., 1965.

Two measurements made on the gravity map, the total anomaly and maximum gradient, and the use of gravity nomographs, are all that is necessary to solve fault problems when the geometry of the structures is near the ideal and assignment of densities is realistic.—from author's abstract

1593 **Cushman, R. L.** An evaluation of aquifer and well characteristics of municipal well fields in Los Alamos and Guaje Canyons near Los Alamos, New Mexico: U.S. Geol. Survey Water-Supply Paper 1809-D, p. D1-D50, illus., tables, 1965.

This report describes the construction features and water-yielding characteristics of the wells in relation to the main aquifer, the Tesuque Formation and younger Santa Fe Group. Hydraulic properties of the main aquifer (transmission and storage of water) as determined from pumping tests are evaluated, and a method is outlined for computing these properties using pumpage and water-level fluctuation data from 1946 to 1962.—W.L.G.

Cushman, R. V. *See* Pohl, E. R. 1752

Cutshall, Norman. *See* Osterberg, Charles. 1795

1725 **Czamanske, Gerald K.; Porter, Stephen C.** Titanium dioxide in pyroclastic layers from volcanoes in the Cascade Range: Science, v. 150, no. 3699, p. 1022-1025, illus., tables, 1965.

Rapid determinations of titanium dioxide have been made by x-ray emission techniques to evaluate the potentiality of using the TiO_2 content of samples for checking field correlations and assisting in identification of pyroclastic units from Cascade volcanoes. Preliminary data suggest that the two most wide-spread units have characteristic ranges of TiO_2 content and that other, less extensive layers have ranges which, though characteristic, often overlap the ranges of the more widespread layers. Relative to fresh samples, weathered samples from B and C soil horizons are enriched in TiO_2.—Authors' abstract

1750 **Danes, Z. F.; Bonno, M.; Brau, E.; Gilham, W. D.; Hoffman, T. F.; Johansen, D.; Jones, M. H.; Malfait, B.; Masten, J.; Teague, G. O.** Geophysical investigation of the southern Puget Sound area, Washington: Jour. Geophys. Research, v. 70, no. 22, p. 5573–5580, illus., table, 1965.

The geologic structure of the Puget Sound area has been determined on the basis of detailed surface geology and gravity maps, magnetic observations, earthquake epicenters, and well records. The Puget Sound lowlands are a deep crustal depression separated from the Olympic Peninsula by an active fault of about 4,000 m throw. The basin is divided into 3 main parts by an igneous horst with an older gabbroic core and younger basaltic layers. The northeastern part of the basin has about 10,000 m of sediments; the southern and western parts each have about 4,000 m. The faults along the horst are active.—D.B.V.

1926 **d'Anglejan, B. F.** Studies of some marine phosphorites from Baja California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1758, 1965.

1791 **Darby, David G.; Stumm, Erwin C.** A revision of the Ordovician trilobite *Asaphus platycephalus* Stokes: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 3, p. 63–73, illus., 1965.

The Ordovician trilobite *Asaphus platycephalus* Stokes is determined to be a valid species and is assigned to the genus *Isotelus*. The species is compared with *I. gigas* Dekay, *I. iowensis* (Owen), and *I. maximus* Locke. The Ordovician stratigraphy of St. Joseph Island, Ontario, the type locality of *I. platycephalus*, is reviewed.—Authors' abstract

2015 **Davidson, Charles F.** Geochemical aspects of atmospheric evolution, *in* Symposium on the evolution of the Earth's atmosphere: Natl. Acad. Sci. Proc., v. 53, no. 6, p. 1194–1205, table, 1965.

The syngenetic vs. epigenetic origin of Precambrian and Cambrian adularia shales, banket conglomerate gold–uranium ores, iron formations, red beds, dolomites, and phosphorite deposits is discussed. Results contradict the belief that a primeval reducing atmosphere persisted for much of Precambrian time. The oxygen and CO_2 content of both atmosphere and oceans would appear to be about the same at a very early date as that during the Paleozoic. "Those geologists who advocate Precambrian departures from uniformitarianism must beware lest their evidence be explicable in terms of metasomatic processes, equally manifest in Phanerozoic formations."—E.S.L.

1927 **Davis, Gregory A.** Correlation of Stuart Fork Formation with rocks of western Paleozoic and Triassic belt, Klamath Mountains, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1758–1759, 1965.

1991 **Delevoryas, Theodore.** Ontogenetic studies of fossil plants: Phytomorphology, v. 14, no. 2, p. 299–314, illus., 1964.

Literature on growth patterns of Paleozoic pteridophytes and seed ferns is reviewed. The Carboniferous fern genus *Psaronius* has been shown to have had obconical stems that increased in diameter and complexity from base to apex. Carboniferous arborescent Lycopsida and Sphenopsida had more limited growth distally and approached a determinate type of growth habit. In the seed fern genus *Medullosa*, considerable changes occurred with increasing age.—V.M.J.

1671 **DeLisle, Mark; Morgan, J. R.; Heldenbrand, Jay; Gastil, Gordon.** Lead–alpha ages and possible sources of metavolcanic rock clasts in the Poway Conglomerate, southwest California: Geol. Soc. America Bull., v. 76, no. 9, p. 1069–1074, illus., table, 1965.

Zircons in volcanic rock clasts of the Eocene Poway Conglomerate in San Diego County, Calif., have lead–alpha dates that range from 190 to 260 m.y. Three similar felsites of the Sidewinder and Hodge Volcanic Series in the central Mojave Desert range from 210 to 260 m.y. in age. Because no other similar rocks of this age are known to exist in Southern California or adjacent areas, it is tentatively

concluded that many felsite clasts of the Poway Conglomerate were originally derived from Permian–Triassic rocks of the Mojave Desert.—Authors' abstract

Denison, Rodger E. *See* Ham, William E. 1560

Denison, Rodger E. *See* Muehlberger, William R. 1847

2093 **Deuth, M. J.** Melvin Leroy Irwin (1915–1964): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1728–1729, portrait, 1965.

1844 **DeVoto, Richard H.** Facies relationship between Garo Sandstone and Maroon Formation, South Park, Colorado: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 4, p. 460–462, illus., 1965.

The environment of deposition of the Garo Sandstone was closely associated with that of the Maroon Formation. The Garo is Permian in age and its thickness variations are primarily the result of facies changes.

2008 **Dietz, R. S.** Collapsing continental rises, an actualistic concept of geosynclines and mountain–building—A reply [to discussion of 1963 paper by K. J. Hsu, 1965]: Jour. Geology, v. 73, no. 6, p. 901–906, illus., 1965.

Criticisms by Hsu (ibid., p. 897–900) of the author's 1963 article are partly due to confusion in meaning of geographic and tectonic terms applied to geosynclines and their sediment sources. Thus, Dietz' Appalachian eugeosyncline (late Precambrian to Ordovician) became "Appalachia" in the mid–Paleozoic, and is now the Appalachian Piedmont. Hsu's evidence for sialic crust beneath geosynclines is set aside in favor of an interpretation involving faulting of old sialic blocks into areas of oceanic (simatic) crust, tectonic superposition of eugeosynclinal on miogeosynclinal rocks, and the lateral and upward movement of mobile siliceous masses through oceanic crust to form siliceous plutons. Early geosynclinal subsidence is due to purely regional isostatic adjustment, but later subsidence involves folding and faulting.—V.E.S.

1928 **Dill, Robert F.** "Rivers–of–sand" and other erosional processes in submarine canyons [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1759, 1965.

2101 **Dillman, C. Daniel; Polk, Robert R.** Laboratory manual for earth science: Minneapolis, Minn., Burgess Publishing Co., 137 p., illus., tables, 1965.

This manual is intended for use with the Arthur N. Strahler text, *The Earth Sciences*, in a one semester, lecture–laboratory course offered at the college freshman and sophomore levels. Selectivity is necessary in preparing a laboratory manual for such a course, therefore, 19 exercises are provided which refer to the text divisions: the earth as a planet, the atmosphere and oceans, the solid earth, and landscape and soil.—E.S.L.

1749 **Diment, W. H.; Marine, I. W.; Neiheisel, James; Siple, G. E.** Subsurface temperature, thermal conductivity, and heat flow near Aiken, South Carolina: Jour. Geophys. Research, v. 70, no. 22, p. 5635–5644, illus., tables, 1965.

Temperatures were measured in seven drill holes in a 4–sq–km area near Aiken, S. C., that penetrated 300 m of sedimentary rocks and 300 m of basement schists and gneisses. In the metamorphic rocks the mean geothermal gradient is about 15°C per km, mean thermal conductivity about 6.7 μ cal per cm sec °C, and heat flow 1.0±0.1 cal per cm^{2}sec (uncorrected for climatic change or evolution of topography). The disturbing effect of the drilling on the temperature gradient in the metamorphic rocks was small. Details of temperature distribution suggest that the thermal regime in the sediments is influenced by ground–water flow.—D.B.V.

Dixon, G. H. *See* Beaumont, E. C. 2014

2111 **Dixon, H. Roberta; Shaw, Charles E., Jr.** Geologic map of the Scotland quadrangle, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-392, scale 1:24,000, sections, separate text, 1965.

Bedrock in the Scotland quadrangle consists of the Scotland Schist and the Canterbury Gneiss whose type areas are in this quadrangle. Glacial deposits are till, sand and gravel; postglacial deposits are eolian silt and sand, alluvium, muck and peat.—M.C.M.

1776 **Dixon, J. R.; Reeves, C. C., Jr.** Representative carbonate petrography of some lower and middle Paleozoic rocks, west flank Teton Mountains, Wyoming: Jour. Sed. Petrology, v. 35, no. 3, p. 704–721, illus., 1965.

Carbonate rocks of early and middle Paleozoic age in northwestern Wyoming include limestone and dolomite of many textures. Insoluble residues are relatively low in these carbonate rocks. Depositional environments varied from shallow water to tidal shelf during Cambrian time, near shore in Devonian time, and a stable shelf during most of Mississippian time.—G.O.B.

1785 **Dodd, J. Robert; Cain, J. Allan; Bugh, James E.** Apparently significant contour patterns demonstrated with random data: Jour. Geol. Education, v. 13, no. 4, p. 109–112, illus., 1965.

An effective method of demonstrating to students that apparently significant patterns can result from contouring inadequate data, is to contour random numbers. Contouring such data gives different results depending on the assumptions made about the data being contoured. Examples are shown of patterns obtained by the mechanical contouring method and by interpretative methods where the random numbers are assumed to be (1) elevations on a topographic surface, (2) elevations of a given stratigraphic horizon, (3) deviations from a trend surface. Apparently geologically reasonable interpretations can be made in each case.—Authors' abstract

2031 **Dodd, R. T., Jr.** Precambrian geology of the Popolopen Lake quadrangle, southeastern New York: New York State Mus. and Sci. Service Map and Chart Ser., no. 6, 39 p., illus., tables, geol. map, 1965.

This quadrangle, in the Hudson Highlands region of the Precambrian Reading Prong, exhibits a complex of sedimentary and, perhaps, volcanic rocks which were metamorphosed, folded, and intruded by granite about 1.1 b.y. ago. The metamorphic rocks are divided into three major types according to origin: shales and graywackes, basaltic volcanic rocks, and those of uncertain parentage. Masses of granite occur as lenses and layers in all. Modal analyses of all types are tabulated. Plastic deformation is indicated by intricate folds and later brittle deformation by joints and faults. Sections and diagrams illustrate the structure.—E.S.L.

1903 **Dollison, Robert S.** Big Hill field, Jefferson County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1749, 1965.

1722 **Domenico, P. A.; Mifflin, M. D.** Water from low-permeability sediments and land subsidence: Water Resources Research, v. 1, no. 4, p. 563–576, illus., 1965.

Seepage pressures are part of the neutral or nondeformative stresses acting in a ground-water basin, which may be transferred to effective stresses by the reduction in pressures. The amount of land subsidence or ground-water recovery from compressible confining layers depends upon the specific storage of the strata and the average head change within them. The geometry of the effective-pressure area depends upon the thickness of the strata, the magnitude of artesian pressure decline, the manner in which the basin is developed, and time. These factors are embodied in equations that quantitatively describe the release of stored water from vertically compressed layers in areas of land subsidence.—G.D.C.

Domenico, Patrick A. *See* Maxey, George B. 1712

Donaldson, J. R. *See* Hacquebard, P. A. 1757

1929 **Douglas, Robert.** Upper Cretaceous planktonic Foraminifera from Yolo and Colusa Counties, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1759, 1965.

1985 **Driscoll, E. G.; Hall, D. D.; Nussmann, D. G.** Morphology and paleoecology of the brachiopod *Leiorhynchus kelloggi* Hall, Middle Devonian, Ohio, Michigan, Ontario: Jour. Paleontology, v. 39, no. 5, p. 916–933, illus., 1965.

Leiorhynchus kelloggi Hall has been found only in the uppermost beds of the Middle Devonian Silica Shale, Plum Brook Shale, and Arkona Shale. The species is found in argillaceous biomicrites and argillaceous fossiliferous micrites deposited in deeper sublittoral environments. Specimens from the Arkona Shale and Plum Brook Shale, on the east side of the Findlay Arch, show a closer morphologic similarity to each other than to specimens from the Silica Shale, on the west side of the Arch. Shell structure, ontogeny, faunal and lithologic associations, and correlation are examined.—Authors' abstract

1774 **Drobnyk, J. W.** Petrology of the Paleocene–Eocene Aquia Formation of Virginia, Maryland, and Delaware: Jour. Sed. Petrology, v. 35, no. 3, p. 626–642, illus., 1965.

Size analyses, mineralogy of both heavy and light fractions of sand-size material, and differential thermal analysis of clay-size material indicate that the Aquia Formation was derived predominantly from the Piedmont, Blue Ridge, and Valley and Ridge provinces and deposited in inner neritic waters. Both authigenic and detrital glauconite are recognized and the heavy mineral suite lacks only hornblende. Illite, montmorillonite, and kaolinite make up the clay fraction.—H.A.T.

1740 **Dyck, W.; Fyles, J. G.; Blake, W., Jr.** Geological Survey of Canada radiocarbon dates IV: Canada Geol. Survey Paper 65–4, 23 p., tables, 1965.

This paper reports ages determined in the C^{14} Dating Laboratory of the Geological Survey between December, 1963 and November, 1964. It is reprinted directly from "Radiocarbon," v. 7, p. 24–46, 1965.—Authors' abstract

Eckart, D. W. *See* Kohn, J. A. 2032

Edwards, K. W. *See* Barker, F. B. 1595

1964 **Elias, M. K.** Stratigraphy and paleoecology of some Carboniferous bryozoans, *in* Internat. Cong. Stratigraphie et Géologie du Carbonifère, 5th, Paris, 1963, Compte Rendu, v. 1: Paris, Louis-Jean—GAP, p. 375–382, illus., 1964.

A new biometric method for study of fenestrate bryozoan colonies by color, is based on the measurement of the distance between successive transverse bars that connect subparallel branches. Some variation is irregular, but others develop bands or zones in the zoarium. Color mosaics of three American colonies are given to illustrate the method; the procedure is outlined. Taxonomic notes and descriptions of *Fenestella rudis* are included.—E.S.L.

2004 **Elliott, David.** The quantitative mapping of directional minor structures: Jour. Geology, v. 73, no. 6, p. 865–880, illus., tables, 1965.

Directional properties of linear features in rocks, and of the planar structures in which they may occur, are the rake, plunge, dip, and trend-strike angle. The rake, which is the inclined angle between the linear feature and the strike of the planar structure, generally varies more rapidly than either plunge or trend-strike and therefore is the preferred directional property for constructing isogonic maps and profiles. Field control stations where directional measurements are taken should be carefully spaced over the area, preferably not on a grid.—A.T.M.

1840 **Ellis, Michael J.; Adolphson, Donald G.** Hydrogeology of the glacial drift in the Skunk Creek–Lake Madison drainage basin, southeastern South Dakota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-195, scale 1:125,000, separate text, 1965.

The map sheet includes an index map showing major drainage basins in eastern South Dakota underlain by glacial drift, and the area covered by this report; a map of glacial deposits and data-collection points; a map of saturated thickness and geologic sections of outwash deposits; graphs of drawdown curves, precipitation, discharge, and fluctuations of water levels; and a map of water-bearing deposits and water analysis patterns of chemical quality. The text describes the geography, surficial geology, and hydrogeology of the area and tables summarize the analyses of the water.—M.C.M.

1858 **Elston, Wolfgang E.; Snider, Henry I.** Differentiation and alkali metasomatism in dike swarm complex and related igneous rocks near Capitan, Lincoln County, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 140–147, illus., tables, 1964.

The most probable sequence of magmatic events in the Carrizo Mtn.–Indian Divide–Nogal area is: (1) eruption of thousands of feet of pyroxene andesite flows, (2) intrusion of a NNE-trending dike swarm extending from Sierra Blanca Peak 40 mi to Jicarilla Mtn., (3) intrusion of felsic stocks and laccoliths. Magmatic differentiation resulted in a strong concentration of sodium and potassium in the late magmatic and post-magmatic stages. Dike rocks are divided into seven types and the descriptions are tabulated.—E.S.L.

1931 **Enbysk, Betty J.** Coiling direction ratios of Foraminifera *Globigerina pachyderma* (Ehrenberg) in northeastern Pacific surface sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1760, 1965.

Ericson, D. W. *See* Weeks, E. P. 1833

Ethington, R. L. *See* Clark, D. L. 1883

Eugster, Hans P. *See* Wones, David R. 2048

Evans, Bernard W. *See* Gross, Eugene B. 2046

1932 **Evitt, William R.** Archeopyle in fossil dinoflagellates [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1760, 1965.

1933 **Evitt, William R.; Warren, John S.** Palynological survey of certain Mesozoic–Tertiary strata in California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1760, 1965.

Ewing, John I. *See* Houtz, R. E. 1699

Fay, Leo F. *See* Grantz, Arthur W. 2087

Feth, J. H. *See* VanDenburgh, A. S. 1723

1881 **Feth, J. H.** Selected references on saline ground-water resources of the United States: U.S. Geol. Survey Circ. 499, 30 p., 1965.

This report lists selected references dealing with occurrence of saline ground water in the United States. The indexes direct attention to distribution by States or to geochemistry, sea-water encroachment, and oil-field brines.—W.L.G.

Finlayson, C. Pratt. *See* Marcher, Melvin V. 1733

2035 **Fischer, Alfred G.** Fossils, early life, and atmospheric history, *in* Symposium on the evolution of the Earth's atmosphere: Natl. Acad. Sci. Proc., v. 53, no. 6, p. 1205–1215, illus., 1965.

The Berkner–Marshall theory suggests that the beginning of Cambrian time marks the attainment of one percent of present oxygen pressure, allowing the widespread appearance of sea animals, and that by Silurian–Devonian time oxygen pressure had risen to ten percent of present level, thereby reducing ultraviolet radiation at

land surface to tolerable levels and permitting the widespread appearance of forests. The fossil record does not prove the theory, but the theory offers plausible explanations for these two major events which have hitherto been baffling.—E.S.L.

1857 **Foley, Edward J.** The Lincoln folds, Lincoln, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 134–139, illus., 1964.

Only those folds on the north side of the Rio Bonito, in the immediate vicinity of Lincoln are discussed. The writer believes they are the result of landslides or slumps that took place in late Pleistocene or early Recent time. Stereo airphoto pairs and triplets of the deformed area are included.—E.S.L.

1934 **Ford, Donald M.; Huntting, Marshall T.** Recent oil and gas exploration activities in Washington [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1760–1761, 1965.

Frezon, Sherwood E. *See* Glick, Ernest E. 2096

1786 **Friedman, Gerald M.** Terminology of crystallization textures and fabrics in sedimentary rocks: Jour. Sed. Petrology, v. 35, no. 3, p. 643–655, illus., 1965.

There is a need for terminology to describe crystallization textures and fabrics in sedimentary rocks. At present such terms are borrowed from igneous and metamorphic petrology with resultant confusion and inconsistencies. The terms *xenotopic*, *hypidiotopic*, and *idiotopic* are proposed for crystallization fabric for both inequigranular and granular fabrics. The terms *porphyrotopic* and *poikilotopic* describe inequigranular fabrics. The terms *anhedral*, *subhedral*, and *euhedral* are recommended for more extensive usage in describing carbonate texture.—G.O.B.

2057 **Friedman, Gerald M.** Occurrence and stability of aragonite, high magnesian calcite and low magnesian calcite under deep-sea conditions: Geol. Soc. America Bull., v. 76, no. 10, p. 1191–1196, illus., 1965.

Recent deep-sea carbonate sediments contain abundant low-Mg calcite whereas shallow water sediments are high in high-Mg calcite and aragonite. Selective dissolution of the less stable aragonite and high-Mg calcite, especially in finer size fractions, produces the enrichment in low-Mg calcite.—J.J.H.

Friedman, Melvin. *See* Carter, Neville L. 1822

Frye, John C. *See* Morrison, R. B. 1745

Fullerton, Donald S. *See* Wilson, Charles W., Jr. 1677

Fullerton, Donald S. *See* Colvin, John M., Jr. 1679

Fyfe, W. S. *See* Campbell, A. S. 1963

Fyles, J. G. *See* Dyck, W. 1740

2050 **Gaines, Richard V.** Moctezumite, a new lead uranyl tellurite: Am. Mineralogist, v. 50, no. 9, p. 1158–1163, tables, 1965.

Moctezumite, an orange-colored bladed uranyl tellurite growing in rosettes, occurs in the oxidized zone of the Moctezuma mine, Sonora, Mexico. X-ray fluorescence analysis showed Pb, Te, and V to be the only heavy elements present. The formula, X-ray powder, and single crystal data are given.—M.L.L.

1673 **Gallagher, David.** On lantern slides: Geol. Soc. America Bull., v. 76, no. 9, p. 1081, 1965.

Before photography, look at the original from as many feet away as it is inches wide, and you will see it as it will look to the audience as a slide on the screen.—Author's abstract

1935 **Gallear, Darrell C.; Kistler, James O.** 29D Monarch and 10-10 pool, a "sleeper" in old Midway-Sunset field, Kern County, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1761, 1965.

2059 **Ganopole, Gerald.** The great Alaskan earthquake, *in* Guidebook, field trip routes, Anchorage to Sutton, 1963; Sutton to Caribou Creek, 1964—Oil fields, earthquake, geology: Anchorage, Alaska, Alaska Geol. Soc., p. 23-24, illus., 1964.

The energy released at the epicenter of the March 27, 1964 earthquake was nearly twice as great as that released in the 1906 San Francisco quake. The displacement up to the east and down to the west makes the fault seem more closely related to a continental orogenic zone than to the Aleutian Trench system. Landslides caused by the earthquake in the Anchorage area are described and an airphoto of the Turnagain slide area is included. In this area horizontal displacement was as great as 1,200 feet.—E.S.L.

Gastil, Gordon. *See* DeLisle, Mark. 1671

Gatlin, Beverly. *See* Rogers, John J. W. 1893

1968 **Getz, Lowell L.; Hibbard, Claude W.** A molluscan faunule from the Seymour Formation of Baylor and Knox Counties, Texas: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 275-297, illus., tables, 1965.

The mollusks and vertebrates found associated directly below the Pearlette ash in the Seymour Formation, constitute a faunule in the Cudahy fauna, here named the Vera faunule. The possible correlation and age of the Seymour Formation are discussed. The mollusks are listed and habitat indications tabulated. The character of the Vera molluscan faunule is indicative of cooler, more moist summers in northern Texas in late Kansan times.—E.S.L.

1814 **Gilbert, M.; Laudelout, H.** Exchange properties of hydrogen ions in clays: Soil Sci., v. 100, no. 3, p. 157-162, illus., 1965.

A calculation of the free energy of exchange shows that substitution of sodium by hydrogen ions is an exergonic process, while the reverse is true for the substitution of ammonium by hydrogen ions. Direct calorimetric measurements of the heat of exchange show that substitution of the sodium by the hydrogen is an exothermic process and an endothermic process for the substitution of ammonium by hydrogen ions.—J.W.H.

Gilham, W. D. *See* Danes, Z. F. 1750

1902 **Gilreath, J. A.** Log characteristics of diapiric shales [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1749, 1965.

1708 **Gimlett, James I.** Gravity survey, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 40-46, illus., 1964 [1965].

This survey investigated the flanks of the Sand Springs Range and the neighboring valleys for a possible Project Shoal site. Its purpose was to determine the Basin-Range fault pattern and to estimate the displacements involved. The method was effective because of the large density contrast between the dense metamorphic and granitic rocks comprising the range and the less dense sedimentary and possibly volcanic deposits of the valleys. Six gravity stations were used and six east-west profiles and a gravity map were prepared. A gravity high marks the range but its crest is displaced to the west and probably represents a thick metamorphic section.—M.C.

1709 **Gimlett, James I.** Refraction survey, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 49-53, illus., 1964 [1965].

This seismic survey supplemented aeromagnetic and gravity data and helped to solve geological-geophysical problems, in connection with selection of the Project Shoal site. Refraction studies provided accurate depth-of-fill data on the west, dip of bounding faults on the east, and depth to bedrock in Fairview Valley. Three sets of refraction profiles running east-west with 2,400 ft spreads were prepared from the drill holes. Tests on granite in the possible site area produced low velocities probably caused by weathering and relatively open fracture cleavage. The profiles indicated the thinness of alluvium in Fourmile Flat, a high-velocity medium representing a 114 ft section of metamorphic rock underlain by granite and, in Fairview Valley, the compactness of the till, water-table position, and depth to granite.—M.C.

1710 **Gimlett, James I.** Aeromagnetic survey, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 46-49, illus., 1964 [1965].

The primary purpose of the survey was to delimit the granitic body of the Sand Springs Range vertically and horizontally, in connection with site selection for Project Shoal. In addition, the data were expected to help resolve various geologic problems which might arise during the geologic and gravimetric mapping. The area was covered by 39 east-west and 4 north-south profiles and the data were contoured at a 50 gamma interval. The limits of surface exposures of the granite are marked by prominent magnetic lows where they abut against the metamorphics, which are characterized by magnetic highs.—M.C.

2096 **Glick, Ernest E.; Frezon, Sherwood E.** Geologic map of the Snowball quadrangle, Newton and Searcy Counties, Arkansas: U.S. Geol. Survey Geol. Quad. Map GQ-425, scales 1:62,500 and 1:24,000, sections, separate text, 1965.

The entire Snowball quadrangle map has a scale of 1:62,500, and the bedrock geologic map of the northwestern part 1:24,000. Sections for each map omit Quaternary deposits. Formations range from Ordovician Powell Dolomite to Cason Shale, Silurian St. Clair Limestone, and Carboniferous Boone Formation to Atoka Formation. Deposits of Pleistocene(?) and Recent age are present mostly along major streams. No single horizon crops out over enough of the area to furnish unitary structural control. Several of the valleys appear to be structurally low, but evidence for this may be invalid. Three structurally high areas are the southern end of the Mount Hersey Dome, and the Dry Creek and Calf Creek highs.—M.C.M.

Glover, Everett D. *See* Sippel, Robert F. 1793

1994 **Goldberg, B. Abbott.** The role of the Department of Water Resources in earthquake investigations, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 7-11 [1965].

The history of the Department's earthquake engineering studies, especially in connection with California's water facilities is given informally. Problems encountered in connection with the State Water Project are mentioned particularly.—E.S.L.

2006 **Goldsmith, J. R.; Northrup, D. A.** Subsolidus phase relations in the systems $CaCO_3$-$MgCO_3$-$CoCO_3$ and $CaCO_3$-$MgCO_3$-$NiCO_3$: Jour. Geology, v. 73, no. 6, p. 817-829, 1965.

Subsolidus phase relations in the above ternary systems were investigated at 600°, 650°, 700°, and 750°, and at 600°, 700°, and 750°, respectively, in squeezer-type equipment mostly at 15 kb applied pressure. The configuration of the system with $CoCO_3$ is similar to that of the system $CaCO_3$-$MgCO_3$-$FeCO_3$; the system with $NiCO_3$ is more complex, solid solubility is less, and a solubility gap interrupts the $MgCO_3$-$NiCO_3$ binary. Dolomite-type compounds $CaCO(CO_3)_2$ and $CaNi(CO_3)_2$ do not exist.—from Author's abstract

1767 **Goldstein, J. I.** The formation of the kamacite phase in metallic meteorites: Jour. Geophys. Research, v. 70, no. 24, p. 6223-6232, illus., tables, 1965.

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The newly determined Fe–Ni phase diagram of Goldstein and Ogilvie (1965) was applied and a diffusion analysis was developed to predict concentration gradients in meteoritic kamacite. It is found that for cooling rates of about 2×10^{-6} degree per yr the kamacite phase cannot remain in equilibrium at low cooling temperatures and that a nickel depletion in the kamacite near the α–γ interface occurs below 450°C. Certain other features of the kamacite phase are predicted and these predictions are confirmed by electron probe measurements of several meteorites. Thus the composition of the kamacite phase can be predicted from cooling rates of parent bodies formed at low pressure.—D.B.V.

Goldthwait, Richard P. *See* Borns, Harold W., Jr. 2072

2073 **Golomb, Berl.** Evaluation of landscape change in the Basin of Mexico [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 616, 1965.

Gonzalez, C. L. *See* Carter, D. L. 1832

1731 **Gooding, Ansel M.; Martin, Charles W.** An aid to teaching the principles of geologic map interpretation: Jour. Geol. Education, v. 13, no. 4, p. 117, illus., 1965.

The teaching aid is constructed of art board, hinged with tape so that when it is folded the surface shows a geologic map, which the student interprets and then opens a leaf to reveal a third-dimension view by which he can check the interpretation.—E.S.L.

1936 **Gorsline, D. S.** Oriented sampling in continental borderland [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1761, 1965.

Goulben, B. *See* Bradford, G. R. 1811

1937 **Grant, W. E.** Background and history of Outer Continental Shelf mineral leasing program [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1761, 1965.

2087 **Grantz, Arthur W.; Fay, Leo F.** Geologic road log of the Matanuska Valley, Sutton to Caribou Creek, *in* Guidebook, field trip routes, Anchorage to Sutton, 1963; Sutton to Caribou Creek, 1964—Oil fields, earthquake, geology: Anchorage, Alaska, Alaska Geol. Soc., p. 16–22, 1964.

The Matanuska Valley is a narrow down-faulted valley, principally underlain by Cretaceous and Tertiary rocks. The valley was excavated by multiple advances of the Matanuska Glacier during the Pleistocene, and by the river during interglacial and postglacial time. The river now flows in a steep-walled canyon as much as 400–600 feet below the floor of the Wisconsin stage glacier.—E.S.L.

1583 **Green, J. H.; Hutchinson, R. D.** Ground-water pumpage and water-level changes in the Milwaukee–Waukesha area, Wisconsin, 1950–61: U.S. Geol. Survey Water-Supply Paper 1809-I, p. I1–I19, illus., 1965.

From 1950 to 1961 water levels in the deep sandstone aquifer continued to decline throughout most of the area in response to continued, though diminished, heavy withdrawals from the four major centers of pumpage. At one locality, water levels rose because of discontinued municipal pumping. Future trends of the pumpage pattern may cause additional declines in Waukesha County, but allow recovery in parts of Milwaukee County.—W.L.G.

2127 **Gremillion, L. Ray.** Miocene near-shore deposits of attapulgite: Coastal Research Notes, no. 11, p. 11–12, 1965.

In Florida, Georgia, and South Carolina, attapulgite occurs in the Hawthorn and Tampa Formations, which extend over 60 sq mi. The minable attapulgite was deposited in a Miocene fault trough which subsided throughout Tampa and most of Hawthorn time, and was in the last stages of subsidence by the time the

commercial deposits accumulated. Volcanic ash from Miocene eruptions in south Texas fell in this area and was altered to form the deposits.—E.S.L.

1762 **Gretener, P. E.** Can the state of stress be determined from hydraulic fracturing data?: Jour. Geophys. Research, v. 70, no. 24, p. 6205–6212, illus., table, 1965.

In 1957 Hubbert and Willis demonstrated that under favorable conditions two principal stresses can be determined from hydraulic fracturing data. More recently Scheidegger (1960,1962), Dunlap (1963), and Kehle (1964) have determined all three principal stresses from such data. The latter authors concluded that the maximum horizontal stress is either of the same order of or in many instances appreciably greater than the overburden pressure. It can be shown, however, that the high values for the maximum horizontal stress are a consequence of the assumptions rather than of the data on which the computations are based.—Author's abstract

Griggs, Allan B. *See* Hobbs, S. Warren. 2045

Griggs, Clayton D. *See* Semken, Holmes A. 1969

1590 **Grim, Ralph E.** Some industrial applications of fundamental clay mineralogy, *in* Internat. Clay Conf., Stockholm, 1963, Proc., V. 2: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 21), p. 389–398, discussion, p. 435–437, 1965.

The properties of clay materials that largely determine their use are rooted in the atomic structure and composition of the clay minerals, as are the properties that the engineer needs to know to evaluate soils in construction problems. Recent developments in fundamental clay mineralogy are reviewed: kaolin, bentonite, illitic clays, soil mechanics, and attapulgite clays are discussed.—G.D.C.

1859 **Griswold, George B.** Mineral resources of Lincoln County, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 148–151, illus., 1964.

From 1880–1906 in Lincoln County, N. Mex., four million dollars worth of gold, coal, iron, silver, copper, and lead was produced. Since 1906, only one and a fourth million dollars worth has been produced. However, the County has received new attention by exploration companies, centered on the iron deposits, molybdenum occurrences on Nogal and Sierra Blanca peaks, silver veins along Bonito Creek, and coal in the Mesaverde Formation.—E.S.L.

2046 **Gross, Eugene B.; Wainwright, John E. N.; Evans, Bernard W.** Pabstite, the tin analogue of benitoite: Am. Mineralogist, v. 50, no. 9, p. 1164–1169, illus., tables, 1965.

Pabstite, a new barium tin titanium silicate occurs in siliceous limestone at Santa Cruz, Calif. Properties, formula, cell size, and X ray powder diffraction data are given.—M.L.L.

2049 **Gross, Eugene B.; Heinrich, E. William.** Petrology and mineralogy of the Mount Rosa area, El Paso and Teller Counties, Colorado—[Pt.] 1, The granites: Am. Mineralogist, v. 50, no. 9, p. 1273–1295, illus., tables, 1965.

The Mount Rosa area includes many small segregations (fayalite granite and porphyritic granite) and sill-like bodies of igneous rocks in an arc-like pattern within the Pikes Peak batholith. The Mount Rosa alkalic riebeckite granite is an irregular sheet, 1 by 4 miles in plan, less than 150 feet thick, intrusive into Pikes Peak granite. Age determinations on zircons of Mount Rosa granite and on riebeckite of the granite and pegmatites gave satisfactory ages of 1040 m.y. Field relationships, ages, petrological and mineralogical characteristics support the theory that the Pikes Peak, Windy Point, Mount Rosa and fayalite granites are comagmatic.—B.C.H.

Gualtieri, J. L. *See* Carter, W. D. 2091

2120 **Gulf Coast Assoc. Geol. Socs.** Field trip, the deltaic Coastal Plain, guidebook, 15th annual meeting, October 1965: Houston, Tex., Houston Geol. Soc., 71 p., illus., table, geol. map, 1965.

The deltaic plain of the Brazos River in the Houston area is the subject of this guidebook. Features of the Pleistocene are compared with those of the Recent delta, and an attempt is made to work out Pleistocene stratigraphy. An airphoto mosaic and a photogeologic map of southeastern Brazoria County are included. Several salt-dome oil fields are described.—E.S.L.

Guliov, Paul. *See* Brindle, J. E. 1894

1830 **Gupta, G. C.** Aggregate-size distribution in wet and dry state by Yoder's water stable analysis technique: Soil Sci., v. 100, no. 5, p. 319–322, illus., 1965.

In wet-sieve analysis, the stable aggregates may in some cases swell. The size of the aggregates thus seems to be larger than they were in their original state. Drying in the oven at low temperature will shrink the aggregates to their normal size with negligible breakdown. To overcome this defect in the wet-sieving technique, the author suggests that soils be wet-sieved on a single small-mesh sieve, dry the water-stable aggregates, and fractionate by dry-sieving.—J.W.H.

2054 **Gwinn, V. E.; Mutch, T. A.** Intertongued Upper Cretaceous volcanic and nonvolcanic rocks, central western Montana: Geol. Soc. America Bull., v. 76, no. 10, p. 1125–1144, illus., tables, geol. map, 1965.

Upper Cretaceous intertonguing volcanic and nonvolcanic rocks, 4,000 to 8,000 feet thick, a western facies of the Elkhorn Mountains Volcanics, exposed in a 9-mile-long belt west of Garrison, Mont., are named the Golden Spike Formation. A thin sequence of fluviatile nonvolcanic clastics, derived from Laramide orogenic uplifts to the west and northwest, dominates the northwestern part of the belt, and intertongues southeastward with a thick sequence of lavas and of volcaniclastic rocks probably deposited by mud flows, landslides, and running water from the Elkhorn Mountains volcanic field. Pyroclastics did not reach the area of fluviatile nonvolcanic deposition either because explosive activity was minimal or because prevailing winds were westerly then as now.—E.H.L.

1757 **Hacquebard, P. A.; Donaldson, J. R.** Stratigraphy and palynology of the Upper Carboniferous coal measures in the Cumberland basin of Nova Scotia, Canada, *in* Cong. Internat. Stratigraphie et Géologie Carbonifère, 5th, Paris, 1963, Compte Rendu, V. 3: Paris, Louis-Jean—GAP, p. 1157–1169, illus., tables, 1964.

The Cumberland Group, 9,000 feet of intermontane clastic sediments, has been divided into five units. The lithology and stratigraphic sequences of the coal-bearing facies, represented in the Joggins and Springhill coalfields, are graphically illustrated. These fields, lying on opposite flanks of the major syncline, are believed by the authors to be contemporaneous. A study of miospore genera in 35 coal seams indicates that none of the 28 genera are restricted within this facies; however, on the basis of a lower zone high in *Lycospora* the two coalfields are correlated, and a middle Westphalian B age is indicated for the Joggins Formation. The upper zone (Shulie Formation) is a lower Westphalian C equivalent, formerly assigned a Westphalian B age.—G.D.C.

Hagner, A. F. *See* Collins, L. B. 2042

1684 **Hagni, Richard D.** Igneous rock nomenclature chart for petrology students: Jour. Geol. Education, v. 13, no. 4, p. 105–108, tables, 1965.

This chart, based on the familiar parameters of mineralogy and texture, is useful because of the wide range of igneous rocks included. It provides a simple diagram from which the students can readily grasp the approximate mineralogy and texture of the igneous rock terms encountered in their reading.—E.S.L.

1559 **Hale, W. E.; Reiland, L. J.; Beverage, J. P.** Characteristics of the water supply in New Mexico: New Mexico State Engineer Tech. Rept. 31, 131 p., illus., tables, 1965.

In this arid region the annual precipitation averages about a foot, of which only 3 percent runs off in streams; the rest returns to the atmosphere or percolates into the ground. A land of contrasts, New Mexico encompasses the junction of the Interior Plains, the Southwestern Desert, and the Rocky Mountains; its few perennial streams are fed mostly from its higher mountains and Colorado. The history of hydrologic investigations is reviewed, and descriptions given of the water-bearing formations, areal distribution of alluvial, limestone, and sandstone aquifers, and depth to water and its quality in the different regions. Where fresh water is in short supply, somewhat saline water is used. Large quantities of saline ground water are considered part of the resources.—G.D.C

Hall, D. D. *See* Driscoll, E. G. 1985

1863 **Hall, F. R.** Chemistry of water of a section of the eastern flank of the Sacramento Mountains, Lincoln and Otero Counties, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 161–170, illus., tables, 1964.

This area is of interest because ground water occurs in several major rock types, and because it is a source of recharge to the Roswell artesian basin. Ground and surface waters are predominantly calcium sulfate to calcium bicarbonate-sulfate types characterized by waters from the Tertiary igneous rocks, the San Andres Limestone, and the Yeso Formation. Chemical analyses of water from wells, springs, and streams are tabulated, and displayed in expanded trilinear graphs. Water from each formation is discussed. A generalized section giving the physical character of each formation is included.—E.S.L.

1864 **Hallinger, Donald E.** Caves of the Fort Stanton area, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 181–184, illus., 1964.

There are a number of caves in the Fort Stanton area, some well known. They occur in the San Andres Limestone, and are of interest because of their speleothems, and their past usage by man. The geologic development of the caves and formation of speleothems are discussed.—E.S.L.

1560 **Ham, William E.; Denison, Rodger E.; Merritt, Clifford A.** Basement rocks and structural evolution of southern Oklahoma—A summary: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 7, p. 927–934, illus., 1965.

This is a summary of the paper published in Oklahoma Geol. Survey Bull. 95, 302 p., 1964; and a reprint from the Ardmore Geol. Soc. Field Conference Guidebook for 1963.—E.E.G.

2055 **Hamblin, W. K.** Origin of "reverse drag" on the downthrown side of normal faults: Geol. Soc. America Bull., v. 76, no. 10, p. 1145–1164, illus., 1965.

Detailed field studies along the Hurricane and Grand Wash faults in the western Colorado Plateau reveal that reverse drag flexures extend practically the entire lengths of these faults. The flexure is a broad asymmetrical arc on the downthrown block, approximately 1 mile wide, with maximum dips of more than 30° near the fault plane. The dip of the fault plane decreases downward, and reverse drag has been formed repeatedly during recurrent movement along the faults. It is concluded that normal movement on the curved fault surface tends to pull the blocks apart and leave a gap at the time they are displaced vertically. As the strata bow downward to fill the gap, reverse drag is developed.—H.C.W.

2098 **Hamilton, E. I.** Applied geochronology: London and New York, Academic Press, 267 p., illus., tables, 1965.

The first chapter is devoted to the history of geochronological methods, including radioactivity, and the second reviews general methods. A chapter is devoted to each of the following methods: C–14, K–Ar, Rb–Sr, Re–Os, U–Th–Pb, radiation damage, and common lead. Dating modern sediments, meteorite ages, and the geologic time scale are considered in the last three chapters. Many of the samples are from North America. Both an author and subject index are included.—E.S.L.

1582 **Hamilton, Robert M.** Temperature variation at constant pressures of the electrical conductivity of periclase and olivine: Jour. Geophys. Research, v. 70, no. 22, p. 5679–5692, illus., 1965.

The electrical conductivity of periclase and olivine (10.4 and 17.5 percent fayalite) was measured under uniaxial pressures to 42 kb at temperatures to 1,200°K. The activation energy of periclase is about 1 ev and does not change with pressure to 42 kb. Comparison of results from conductivity, thermoelectric power, transport-number, ion-diffusion, and absorption studies demonstrates the difficulties in deducing the type of charge carriers in periclase. For olivine an increase in fayalite content results in an increase in conductivity, a decrease in activation energy, and a greater pressure dependence for the activation energy; the activation energy decreases with increasing pressure.—Author's abstract

Hansen, Edward. *See* Scott, William H. 1892

2104 **Hansen, Wallace R.** Effects of the earthquake of March 27, 1964, at Anchorage, Alaska: U.S. Geol. Survey Prof. Paper 542–A, p. A1–A68, illus., tables, geol. map, 1965.

The great damage at Anchorage resulting from the earthquake on March 27, 1964, was caused by direct seismic vibration, ground cracks, and landslides. Direct vibrations affected multistory buildings and buildings with large floor areas because of the large amplitude and long period of the seismic waves. Ground cracking occurred for the most part near heads of or within landslides but was scattered in many other areas. Landslides caused the greatest damage. Some of the slides moved by rotation but all of those within Anchorage were of the translation type. They moved laterally on a nearly horizontal slip surface following loss of strength in weak zones of the Bootlegger Cove Clay; physical properties of this clay are discussed. Destructive translatory slides that occurred in the downtown area, at Government Hill, and at Turnagain Heights, are discussed in detail.—V.S.N.

Hardt, William F. *See* White, Natalie D. 1801

1664 **Harker, Peter; Mahoney, Leona R.** (compilers) Report of activities, Pt. 2: Canada Geol. Survey Paper 65–2, 79 p., illus., tables, 1965.

This report comprises a number of short abstract-type papers presenting results of current scientific work of the Geological Survey, that will eventually be described in full in one of the Survey's publications, or in one of the scientific journals.—E.S.L.

1660 **Harms, John C.** Sandstone dikes in relation to Laramide faults and stress distribution in the southern Front Range, Colorado: Geol. Soc. America Bull., v. 76, no. 9, p. 981–1002, illus., geol. map, 1965.

The Front Range is more likely a result of vertical uplift than horizontal shortening, on the basis of evidence of sandstone dikes which intrude hanging walls of Laramide reverse faults along the mountain border. As dikes seek extension positions, and convex-upward reverse faults must have extension zones in hanging wall whereas concave-upward ones do not, Front Range reverse faults must be convex-upward. Such faults result from vertical uplift rather than horizontal compression. Large and abrupt vertical difference in elevation (2–4 miles) of Precambrian surface in the Range and adjacent basins, large reverse faults or narrow monoclines along its margins, and relative lack of deformation in adjacent basins, are compatible with vertical uplift. All ranges of eastern Rocky Mountains may reflect vertical uplift rather than horizontal shortening.—E.H.L.

Harris, D. C. *See* Mandarino, J. A. 1890

Haskin, Larry. *See* Schmitt, R. A. 2090

1667 **Haught, Oscar L.; Overbey, William K., Jr.** Map of Braxton and Clay Counties showing oil and gas fields, structural contours on top of Greenbrier Limestone: Morgantown, W. Va., West Virginia Geol. and Econ. Survey, scale 1:62,500, 1964.

This map accompanies West Virginia Geol. and Econ. Survey Bull. 29, 1964, by Haught; names of structures are in conformity with the 1962 oil and gas map of West Virginia by Overbey. Stratigraphic columns for Union and Henry districts in Clay County, and for the Salt Lake district in Braxton County are included on the sheet. Contour interval is 20 feet.—M.C.M.

2084 **Haun, John D.; Kent, Harry C.** Geologic history of Rocky Mountain region: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1781–1800, illus., 1965.

Sedimentary rocks were deposited in a geosyncline in the Cordilleran region from late Precambrian to Tertiary time. The present tectonic framework of the Rocky Mountain region began to form during the Late Cretaceous and early Tertiary with the development of uplifts and intermontane basins (Laramide orogeny). Volcanic activity was moderately important on the west during the Cretaceous, but igneous intrusion and volcanic activity became widespread throughout the Rockies in the Tertiary.—A.E.R.

1861 **Havenor, Kay C.** Oil and gas tests in Lincoln County, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 155–158, illus., table, 1964.

Eighteen dry exploratory tests have been drilled. The primary objective was the shallow beds ranging from Permian through Cretaceous. This drilling was the outcome of the presence of the petroliferous San Andres Formation, in conjunction with mappable surface structures, and the occurrences of seeps, oil slicks, and shows. The test wells and possible exploration areas are shown on an index map, and a table gives statistics on the wells.—E.S.L.

Heilman, M. D. *See* Carter, D. L. 1832

Heinrich, E. William. *See* Gross, Eugene B. 2049

Heirtzler, J. R. *See* Talwani, Manik. 1834

Heldenbrand, Jay. *See* DeLisle, Mark. 1671

Helmuth, D. N. *See* Parkinson, L. J. 2061

Hem, J. D. *See* Polzer, W. L. 1768

1597 **Hem, John D.** Reduction and complexing of manganese of gallic acids: U.S. Geol. Survey Water-Supply Paper 1667-D, p. D1–D28, illus., tables, 1965.

Tannic (digallic) and gallic acids for 1:1 complexes with Mn^{+2} in dilute solution. The stability constant of the digallic complex was determined to be $10^{4.9}$ by spectrophotometric studies. Water solutions of tannic and gallic acid can bring 100 parts per million or more of manganese into solution from solid manganese dioxide reagent. The reducing and complexing reactions are most rapid at pH's below 5. The manganese brought into solution was oxidized very slowly at pH's as high as 9.8.—Author's abstract

1564 **Henderson, Bonnie C.** Salaries of earth scientists: Geotimes, v. 10, no. 3, p. 24–25, illus., 1965.

This reprint from the September 1965 issue of Geotimes contains new information in addition to refined and corrected graphs.—M.C.M.

2092 **Henderson, Roland G.** Henry R. Joesting (1903–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1729–1732, portrait, 1965.

1558 **Herold, Laurance C.** Trincheras and physical environment along the Rio Gavilan, Chihuahua, Mexico: Denver Univ. Dept. Geography Pub. Geography Tech. Paper 65–1, 233 p., illus., tables, 1965.

This study deals with aboriginal check dams, called trincheras, and the physical environment in which they are found in the eastern portion of the Sierra Madre Occidental of Chihuahua, Mexico. Data gathered at a temporary weather station are discussed, and comparisons of temperatures and precipitation are made with Nuevo Casas Grandes, a permanent weather station 43 air miles to the northeast. Trincheras are described by dimensions, types, construction, and functions; their relationships with selected terrain features are mapped and discussed. These prehistoric structures for control of soil erosion and irrigation have influenced the terrain morphology in the mountains as well as runoff and hydrology.—G.D.C.

Herreid, G. *See* Richter, D. H. 1584

1585 **Herreid, Gordon.** Geology of the Bear Creek area, Seward Peninsula, Candle quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 12, 16 p., illus., table, geol. map, 1965.

The map area is largely underlain by andesitic greenstone intruded by various acidic rocks. Olivine basalt overlies the greenstone. Dikes and small intrusions seem to be more abundant near the large fault along Bear Creek, but do not follow it. Gold, lead and zinc deposits are associated with mafic syenite dikes. Gold placers exist in the belt, one of which is associated with the Bear Creek lead zinc gold deposit. Geochemical sampling of stream sediments for copper lead zinc indicate an extension of the Bear Creek prospect; results are tabulated.—E.S.L.

1726 **Herreid, Gordon.** Geology of the Omilak–Otter Creek area, Bendeleben quadrangle, Seward Peninsula, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 11, 12 p., illus., table, geol. map, 1965.

The map area extends across the northern part of the Darby Mountains and is underlain by marble and schist which have been folded into north northwesterly plunging folds that are overturned to the northeast. Granitic rocks intrude the schist in the eastern half. Regional metamorphism appears to be closely related to structure, but not to intrusive rocks. A geochemical survey was run on stream sediments for copper, lead, and zinc and the results are tabulated. Indications of tin mineralization are present in the eastern part. Known lead–silver and tin deposits are described.—E.S.L.

1747 **Herreid, Gordon.** A geologic and geochemical traverse along the Nellie Juan River, Kenai Peninsula, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 9, 2 p., geol. map [1965].

Graywacke and interbedded slate plus a scattering of green andesite(?) dikes and barren quartz veins appear by visual and aerial observation to be the same in the remainder of the map area. Contacts are generally sharp, but the large scale structures are mantled. Slaty cleavage cuts across the bedding with some crenulation of contacts and slicing of graywacke beds into lenticular boudins, often many feet long. The regional axis of folding, based on only a few data, probably plunges north of east. Where the rocks are scoured by glaciers, white quartz veins aggregating a foot in thickness were seen to spread out to discontinuous veinlets. The composition of float is constant, with some pyritic calcite veinlets, but geochemical tests showed no other mineralization than traces of copper, lead and zinc.—G.D.C.

1748 **Herreid, Gordon.** Geology of the Bluff area, Solomon quadrangle, Seward Peninsula, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 10, 21 p., illus., tables, geol. map, 1965.

The mining camp of Bluff, on the south coast of the Seward Peninsula, is underlain by schist and marble of early Paleozoic age, in north-trending folds. Gold lodes and placers are located in schist near the marble contact. Between Eldorado Creek and Koyana Creek the Bluff anticline is overturned to the east and plunges north at 18°; in slightly undulating areas the schist overlies marble. The lithology and structure are described and geochemical analyses given, with a little more detail for the Daniels Creek, Koyana Creek, and Swede Gulch mineral deposits. The lode gold is 0.08 to 16 percent arsenic so that in geochemical prospecting arsenic soil anomalies may be a guide. Cinnabar is present in the placers and has been found in small lode pockets on Swede Gulch.—G.D.C.

1938 **Herron, Robert F.** Offshore exploration and developments—Southern Santa Barbara County [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1761, 1965.

1875 **Hertlein, Leo G.** Note concerning the date of issue of Arnold's monograph on the Pliocene and Pleistocene of San Pedro: Veliger, v. 6, no. 3, p. 172, 1964.

"The paleontology and stratigraphy of the marine Pliocene and Pleistocene of San Pedro, California," by Ralph Arnold, published as Volume 3 of the California Academy of Sciences Memoirs, has the issue date of June 27, 1903, on the title page; but earlier dates (apparently printing dates) are shown on every eighth page, from September 22, 1902, on page 9, to June 23, 1903, on page 417. Inquiries in 1955 to the librarian of the Academy and to the author revealed no evidence that any of the pages were distributed separately before the issue date.—V.M.J.

Herzog, Richard F. *See* Poschenrieder, Walter P. 2011

1658 **Hewett, D. F.; Radtke, Arthur; Taylor, Charles.** Black calcite—A source of silver?: Mining Cong. Jour., v. 51, no. 6, p. 78, 1965.

In many mining districts in the western United States, silver has been closely associated with manganese minerals such as rhodochrosite, rhodonite, alabandite, or manganoan siderite. Elsewhere, much cerargyrite has been mined, derived by supergene alteration of unknown hypogene silver minerals, and in some areas, closely associated with manganese oxides. In some districts, black calcite is abundant; laboratory study has shown the black color to be caused by finely dispersed grains of a manganese oxide mineral which often carries silver, from traces up to 5 percent (Hamilton, Nev.). Electron microprobe analysis indicates that the silver is contained in a silver-manganese mineral, probably the primary source of much cerargyrite. Occurrences of black calcite, generally epithermal, should be examined as possible sources of silver ore.—R.R.C.

1730 **Hewitt, Philip C.** The role of the small college geology department in geological education: Jour. Geol. Education, v. 13, no. 4, p. 99–101, 1965.

The role of the small college geology department at present and for the future is to train the undergraduate in breadth, to teach him geology and what a geologist is and does. Small classes and avoidance of specialization, coupled with close faculty association are the techniques involved.—E.S.L.

2030 **Heylmun, E. B.** Reconnaissance of the Tertiary sedimentary rocks in western Utah: Utah Geol. and Mineralog. Survey Bull. 75, 38 p., illus., geol. map, 1965.

The Tertiary beds are divided into basal conglomerates, lower lacustrine, lower volcanic, late Miocene–early Pliocene, middle volcanic, and late Pliocene–Pleistocene sequences. No formation names are assigned although some units can be traced over sizeable areas. Fossils occurring in the beds are listed, and alteration due to weathering and ground water is described. The report includes a map of Tertiary outcrops and Lake Bonneville shorelines, and a stratigraphic column exposed in Tooele County.—E.S.L.

Hibbard, Claude W. *See* Getz, Lowell L. 1968

1680 **His, George.** Woodley (1200') Anacacho Field, Uvalde County, Texas, *in* Upper Cretaceous asphalt deposits of the Rio Grande embayment—Corpus Christi Geol. Soc., Ann. Field Trip 1965: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 31–32, illus., 1965.

In the southeast corner of Uvalde County, gas was found in the Anacacho Limestone which is draped over a "serpentine plug", with minor faulting. A basaltic magma appears to have been extruded toward the close of Austin time and during early Taylor time to form a flat bottomed, roughly cone shaped mound about 200 feet high and 4,000 feet in diameter, which was altered to "serpentine" and subsequently covered by limestones and shales. Differential compaction added closure to the porous zone in the upper part of the Anacacho where the gas was trapped. Two small isopachous maps and a type log illustrate the interval. The four productive wells are shut-in for lack of a market.—G.D.C.

2045 **Hobbs, S. Warren; Griggs, Allan B.; Wallace, Robert E.; Campbell, Arthur B.** Geology of the Coeur d'Alene district, Shoshone County, Idaho: U.S. Geol. Survey Prof. Paper 478, 139 p., illus., tables, geol. maps, 1965.

A restudy of the general geology of the Coeur d'Alene district, one of the larger lead-, zinc-, and silver-producing areas of the world, is presented. The geology was remapped at a scale of 1:24,000 and compiled on five maps from west to east as follows: Smelterville, Kellogg, Wallace, Mullan, and Pottsville. Bedrock, primarily the Precambrian Belt Series which forms the host rock for the ore, is a thick conformable geosynclinal group of fine-grained clastics. Igneous rocks are principally two groups of small monzonitic intrusives and other dikes. Structurally the district is located at the intersection of a major anticlinal arch in the geosynclinal sediments with a major zone of weakness, the Lewis and Clark line; faults are the dominant structural feature. Mineral deposits formed near satellite intrusions of larger igneous bodies intruded during the Mesozoic within a structural knot of highly fractured rocks.—V.S.N.

1751 **Hodgson, J. H.; Wickens, A. J.** Computer-determined P-nodal solutions for the larger earthquakes of 1959–1962 [with French abs.]: Dominion Observatory Ottawa Pubs., v. 31, no. 5, p. 123–143, illus., tables, 1965.

This paper continues the Dominion Observatory program of attempting P-nodal (fault-plane) solutions for all large earthquakes. In this case the solutions have been determined for 66 of the larger earthquakes of 1959–1962 using a computer program described earlier (Wickens, Stevens and Hodgson, 1963). This program does not define the possible variation of the planes from the "best" position determined by the computer, but an attempt has been made to supply this information by inspection of the solutions. The solutions are summarized in the tabular form established in earlier papers of the series.—Authors' abstract

2123 **Hodgson, J. H.; Bath, M.; Jensen, H.; Kvale, A.; Linden, N. A.; Murphy, L. M.; Shebalin, N. V.; Tryggvason, E.; Vesanen, E.** Seismicity of the Arctic, *in* Annals of the International Geophysical Year, 1957–58—V. 30, Seismology: New York, Pergamon Press, p. 33–66, illus., table, 1965.

Studies of seismicity in the Arctic area during IGY were marked by a great expansion in Arctic and subarctic stations and in instrumentation of existing stations; stations are tabulated. There was a marked increase in number of epicenters located; those for which magnitude could be determined are plotted. A plot of earthquakes of $M \geq 5$ reveals one main seismic zone within the Arctic extending from Iceland through Spitzbergen and Prince Josef land, north of Severnaya Zemlya to Siberia at about the Lena River. Other local belts occur in Baffin Bay near the Mackenzie River and north of Bering Strait between Alaska and Siberia. Important minor seismicity is characteristic of all Arctic stations. Earthquakes recorded previous to and during the IGY are tabulated, and a list of 72 references is included.—V.S.N.

Hoffman, T. F. *See* Danes, Z. F. 1750

2074 **Holdsworth, Gerald.** A study of transverse crevasses in the upper Kaskawulsh Glacier, Yukon Territory [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 621, 1965.

2036 **Holland, Heinrich D.** The history of ocean water and its effect on the chemistry of the atmosphere, *in* Symposium on the evolution of the Earth's atmosphere: Natl. Acad. Sci. Proc., v. 53, no. 6, p. 1173–1183, illus., 1965.

This paper is essentially an extension of Sillén's approach to ocean–water chemistry, in which he points out that silicates probably act as pH buffers, along with carbonates. Limits can be set on variations of past ocean–water composition, and these limits set restraints on the atmospheric composition in the past. In discussing controls on the major-element composition of the ocean–atmosphere system, three groups of constituents are found. The first, including chloride in sea water and nitrogen and rare gases in the atmosphere, is controlled by degassing of the Earth; the second, including major cations and pH of sea water and CO_2 in the atmosphere, by mineral equilibria; the third, including sulfate in sea water and oxygen in the atmosphere, by biological reactions.—E.S.L.

Holt, C. L. R., Jr. *See* Weeks, E. P. 1833

2070 **Holzner, Lutz; Weaver, G. D.** Geographic evaluation of climatic and climato–genetic geomorphology: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 592–602, 1965.

The relationship of climate to land-surface morphology and genesis has been investigated by numerous writers for well over half a century. Such studies have focused in part upon interpreting erosional cycles, but more importantly they have to an increasing degree been oriented toward understanding the areal variation of specific surface forms and geomorphic processes. Especially pertinent to the geographer are recent attempts in the United States, and particularly by Julius Büdel in Germany, to use climatic influence as a basis for establishing morphogenetic and climato–genetic regions.—Authors' abstract

1711 **Horton, Robert C.** Physical properties of the drill core, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF–1001, p. 54–59, illus., table, 1964 [1965].

Thermal conductivity, permeability, and elastic properties of a granite core were measured at a possible site for Project Shoal. Core segments taken at 500-foot intervals were measured to a depth of 2,004 feet; no extreme variations in properties were found. At 512, 994, 1,422, and 2,004 feet measurements were, respectively, thermal conductivity 3.6, 3.1, 4.5, and 4.1 g-cal/sec per $cm \times 10^{-3}$ at 100°C; permeability 13.8, 3,100<1, and 390 millidarcies$\times 10^{-6}$; modulus of elasticity for the ranges (psi) 0–1618 and 1618–9708 and for two hysteresis compression curves respectively, in millions, 3 and 5.09, 2.9 and 5.18; 1.7 and 5.03, 1.76 and 5.18; 3.86 and 6.16, 3.86 and 6.73; and 3.41 and 5.68, 3.51 and 5.91.—M.C.

Hose, R. K. *See* Roberts, Ralph J. 2051

1899 **Hottman, C. E.; Johnson, R. K.** Estimation of formation pressures from log-derived shale properties [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1754, 1965.

1998 **Housner, George W.** Earthquake engineering in California, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 28–36, discussion [1965].

A program of basic research is carried forward, as well as recording of destructive ground accelerations during earthquakes, and spectral analysis of the records. Areas needing more research are the nature of destructive ground motions, the nature and extent of permanent ground displacement, the behavior of soils, the dynamics of damaging ground motion, and the possibility of occurrence of tsunamis on the coast of California.—E.S.L.

1699 **Houtz, R. E.; Ewing, John I** Comments on letter by W. A. Knox, "A deep-ocean sedimentary velocity function" [1965]: Jour. Geophys. Research, v. 70, no. 20, p. 5330, 1965.

The validity is questioned of comparing Knox's (ibid., v. 70, no. 18, p. 1999–2001, 1965) velocity functions for the outer ridge of the Puerto Rico Trench, where refracting type sediments occur and special sedimentary conditions may prevail, with those of Houtz and Ewing (ibid., v. 68, no. 18, p. 5233–5258, 1963) which apply only to the relatively transparent sediments found in the deep sea. It is shown that two types of velocity function apply to different parts of the sea, and that unqualified comparison is misleading.—D.B.V.

1839 **Howard, Hildegarde.** Further discoveries concerning the flightless "diving geese" of the genus *Chendytes*: Condor, v. 66, no. 5, p. 372–376, illus., tables, 1964.

A carpometacarpus of *Chendytes lawi*, the first for the genus, a furcula probably of the genus, and the first ulna of *C. lawi* have been found in a late Pleistocene marine terrace deposit on West Anacapa Island, Ventura County, Calif. Characteristics of these elements and of heretofore undescribed parts of the sternum, scapula, and humerus of *C. lawi* are discussed; this material supplements that described by L. Miller et al. (1961) from the same locality. The pectoral elements emphasize the marked degeneration of the flying mechanism; variability in detail of contour is evident where several specimens of each are available. Basic characters sufficient to differentiate *C. lawi* from *C. milleri* are clearly apparent in all pectoral elements that can be compared in the two species.—V.M.J.

2118 **Hsu, K. J.** Collapsing continental rises, an actualistic concept of geosynclines and mountain-building—A discussion [of paper by R. S. Dietz, 1963]: Jour. Geology, v. 73, no. 6, p. 897–900, 1965.

Exceptions are taken to conclusions in an article by R. S. Dietz (ibid., v. 71, no. 3, p. 314–333, 1963) regarding the composition of the thin crust underlying geosynclines, the cause of geosynclinal subsidence, and the source of sediments in geosynclines. Evidence is cited that supports a sialic, rather than simatic, crust beneath geosynclines. Isostatic adjustment under sedimentary loading is only a secondary cause of geosynclinal subsidence; crustal thinning by subaerial erosion and gravity sliding, and mantle density changes probably initiate the subsidence. The major source of geosynclinal sediments is an ancient borderland seaward from the geosyncline, rather than the craton, as indicated by sedimentological studies. The growth of continents by accretion of geosynclinal deposits is thus questionable.—V.E.S.

1910 **Huddleston, Paul F.; Toulmin, Lyman D.** Upper Eocene–lower Oligocene stratigraphy and paleontology in Alabama [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1753, 1965.

Huffman, George G. *See* Branson, Carl C. 1701

1792 **Hume, J. D.** Sea-level changes during the last 2000 years at Point Barrow, Alaska: Science, v. 150, no. 3700, p. 1165–1166, illus., 1965.

Eustatic rises of sea level between A.D. 265 and 500 and between A.D. 1000 and 1100 caused the formation of raised beaches. After the first rise, sea level dropped about 2 meters below the present level, permitting Eskimo settlement of Birnirk about A.D. 500. The second rise of the ocean flooded Birnirk At present, sea level is about 0.6 to 1.0 meter below the high-water levels; the ocean partially floods Birnirk.—Author's abstract

Hunter, Richard G. *See* Renton, John J. 1993

Huntting, Marshall T. *See* Ford, Donald M. 1934

Hutchinson, R. D. *See* Green, J. H. 1583

1789 **Hutchinson, Thomas W.; Stumm, Erwin C.** Upper Devonian and Lower Mississippian pectinoid pelecypods from Michigan, Ohio, Indiana, Iowa, and Missouri: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 1, p. 1–48, illus., tables, 1965.

A restudy of the Upper Devonian and Lower Mississippian pectinoid pelecypods described by C. A. White and Alexander Winchell has resulted in redescription and illustration of four species of the genus *Aviculopecten*, one of *Pseudomonotis*, three of *Euchondria2, and four of Pernopecten.*—Authors' abstract

Ibrahim, M. A. *See* Knop, Osvald. 1742

1990 **Imlay, Ralph W.** Jurassic marine faunal differentiation in North America: Jour. Paleontology, v. 39, no. 5, p. 1023–1038, illus., 1965.

Cosmopolitan Jurassic ammonites and some pelecypods began differentiating in mid-Bajocian time into Boreal, Tethyan and Pacific realms, although there was some intermingling at the edges of the realms and considerable latitudinal shifting. During the Callovian and early Kimmeridgian, Boreal ammonites extended into California; in the late Oxfordian and Portlandian Tethyan forms extended north to southwestern Oregon. Similar shifts took place in Eurasia at the same times and in the same directions, probably due to regional changes within oceans and perhaps also to changes in solar radiation. The primary cause of differentiation probably was the general continental emergence beginning in the Bathonian, which established physical barriers about the middle of the Bajocian. These isolated the realms and resulted in cooling of the Arctic Ocean, and alterations in previous ocean current patterns.—R.E.G.

1940 **Ingle, James C., Jr.** Fluorescent tracer study of eolian sand transport [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1762, 1965.

1773 **Ingram, R. L.** Facies maps based on the megascopic examination of modern sediments: Jour. Sed. Petrology, v. 35, no. 3, p. 619–625, illus., 1965.

A rapid, semi-quantitative method of classifying sediments for use in constructing facies maps is demonstrated for modern nearshore sediments at Morehead City, N. C. The procedure permits the examination of 50–100 samples per day. It is useful in delineating areal variations in color, shell content, minimum size, modal size, dominant sizes and gross lithology.—E.D.M.

2039 **Irish, E. J. W.** Geology of the Rocky Mountain Foothills, Alberta (between latitudes 53°15′ and 54°15′): Canada Geol. Survey Mem. 334, 241 p., illus., tables, geol. maps, 1965.

The stratigraphic succession ranging from Cambrian? to Paleocene is discussed in some detail, and the author attempts to clarify the Cretaceous nomenclature by using the Athabasca River as an arbitrary cut-off boundary for northern nomenclature. Compressive forces have deformed the region from the southwest, and thrusting is the dominant and initial type of deformation. Folding persisted after thrusting ceased, and the mechanism of the folded back-limb thrusts is analyzed. Coal, the most important economic material, and oil and gas potentialities are discussed. Appendices contain detailed measured sections of most formations of the larger coal seams and the logs of oil wells. Fossils are listed.—E.S.L.

2097 **Irish, E. J. W.** Geology, Rocky Mountain foothills, Alberta—Sheet 1, west of sixth meridian; Sheet 2, west of fifth and sixth meridians: Canada Geol. Survey Map 1139A and Map 1140A, scale 1:126,720, 1965.

These maps accompany Canada Geol. Survey Mem. 334, 1965, by E. J. W. Irish. Sections are included on each map.—M.C.M.

1884 **Irwin, M. L.** General theory of epeiric clear water sedimentation: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 4, p. 445–459, illus., 1965.

Three marine hydraulic energy zones in shallow epeiric seas are: a hundreds-of-miles wide, low-energy zone in open sea beneath wave depth (Zone X); an intermediate, high-energy belt, tens of miles wide, beginning where waves first impinge upon the sea floor and extending landward to the limit of tidal action (Zone Y); an extremely shallow, low-energy zone, tens- to hundreds-of-miles wide, occurring landward of Zone Y, in which there is little circulation of water, tides are essentially wanting, and wave action is produced by local storms (Zone Z). In "clear water" epeiric seas receiving no terrigenous clastics, sediments formed in Zone X are mainly fine-grained detritus from Zone Y; in Zone Y are basically of biogenic origin, sand-size or coarser, and most likely to become primary reservoirs; in Zone Z are primarily fine-grained and tight, and of chemical origin.

1727 **Iwamoto, Shigeki; Sudo, Toshio.** Chemical reactions among clay minerals, calcium carbonate, and ammonium chloride: Am. Mineralogist, v. 50, nos. 7-8, p. 886-899, tables, 1965.

Various purifield clay minerals were mixed with varying amounts of $CaCO_3$ and NH_4Cl and heated between 400° and 1100°C for one hour. The reaction products include hydrogrossularite, wollastonite, häuyne, larnite, periclase, forsterite, monticellite, spurite; their identity depends on the nature of the starting material.—E.Z.

1716 **Jaeger, John C.** Application of the theory of heat conduction to geothermal measurements, Chap. 2 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 7-23, illus., tables, 1965.

Mathematical problems encountered in the measurement of heat flow at the Earth's surface are reviewed. Most of these problems can be solved by simple solutions of the equation of heat conduction. Reduction of observations in drill holes for horizontal layering are given by the methods of Bullard and Gough. Described briefly are: heat production; the methods of Jeffreys and Bullard, Lees, and Birch for topographic correction; perturbations of the temperature gradient caused by the oscillations of surface temperature; past climatic changes; uplift and erosion; igneous intrusion; groundwater circulation; mine ventilation; the process of drilling and circulation of drilling fluid; and the sudden insertion of temperature probes. The theory of transient methods for determining thermal conductivity and the effect of anisotropic thermal conductivity are also discussed.—Author's abstract

1984 **Jambor, J. L.; Pouliot, G.** X-ray crystallography of aurichalcite and hydrozincite: Canadian Mineralogist, v. 8, pt. 3, p. 385-389, illus., tables, 1965.

X-ray diffraction studies with Weissenberg, precession, and powder cameras show that aurichalcite is orthorhombic $B22_12$ (not *Pmma* as previously reported) with $a=27.2\pm0.1$, $b=6.41\pm0.02$, $c=5.29\pm0.03$A; observed powder data indexed from these values are given. The morphology of crystals from Mapimi, Mexico, is described; a reported perfect (100) cleavage could not be verified. Measured specific gravity is 3.96 ± 0.03. For hydrozincite from Goodsprings, Nev., known space group and unit cell dimensions were confirmed; twinning about (100) was observed and is illustrated. Indexed powder diffraction data are given. The observed specific gravity is 4.00 ± 0.03.—J.R.C.

2119 **James, Laurence B.** Program and projects of the State Department of Water Resources, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 61-67, discussion [1965].

Several reasons are given for the Department initiating an earthquake program, including the fact that the State is high in incidence of strong earthquakes, and the Department is charged with the safety of more than 900 dams, besides the 300 new dams and hundreds of miles of aqueduct involved in the California Water Plan. Technical studies comprising the program are divided into two categories. The first group relates to geodesy, seismology, and engineering geology, the second to structural and soils engineering. Field and laboratory studies in both groups are briefly described.—E.S.L.

1779 **Janke, N. C.** Empirical formula for velocities and Reynolds' numbers of single, settling spheres: Jour. Sed. Petrology, v. 35, no. 3, p. 749–750, 1965.

A formula is available and has been incorporated in a computer program for obtaining the Reynolds' number of particles ranging in size from .05 mm to 70 mm. The program incorporates use of Stokes Law for particles finer than .05 mm.—R.A.C.

1941 **Jefferson, George T.** Geology and paleontology of a portion of Manix basin deposits, San Bernardino County, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1762, 1965.

1797 **Jenkins, Edward D.** Hydraulic properties of the water-bearing materials, *in* Geology and occurrence of ground water in Otero County and the southern part of Crowley County, Colorado: U.S. Geol. Survey Water-Supply Paper 1799, p. 23–32, illus., tables, 1965.

The hydraulic properties of the principal aquifers in Otero and southern Crowley Counties—the Cheyenne and Dakota Sandstones, Fort Hays Limestone, and Wisconsin terrace deposits—were determined by pumping tests at 23 well sites. The coefficients of transmissibility and storage were computed. Results are summarized in a table, and compared with results of laboratory tests made on 22 samples for transmissibility and grain-size distribution. Calculations based on the field and laboratory measurements indicate that water moves downstream through the alluvial deposits of the main valley at about 5 feet per day or 1/3 mi per year.—V.S.N.

Jenkins, Edward D. *See* Weist, William G., Jr. 1798

Jensen, H. *See* Hodgson, J. H. 2123

2117 **Jensen, M. L.** Bacteriogenic sulfur isotopic ratios in geology: Beitr. Mineralogie u. Petrographie, v. 11, no. 4, p. 405–414, illus., 1965.

Stable sulfur isotopes may aid in distinguishing sulfides of a magmatic hydrothermal origin from sulfides containing biogenic sulfur, because of the difference in variation in δS-34 values. The reason for this is that sulfur produced by anaerobic bacteria is isotopically fractionated by variable amounts. Some raw culture experiments are described.—E.S.L.

Jerome, S. E. *See* Beal, Laurence H. 1707

1838 **Jillson, Willard Rouse.** Discovery of mid-Paleozoic faulting in eastern-central Kentucky: Frankfort, Ky., Roberts Printing Co., 13 p., illus., 1964.

A previously unknown normal fault, here named the Bull Run fault, was discovered by Jillson in southeastern Clark County. It cuts Ordovician–Silurian beds and terminates abruptly against the overlying Middle Devonian. The fault has an average displacement of 40 feet and was traced for three miles. The author believes it developed in late Silurian. Lists of fossils from the beds involved are included and four structure sections showing the fault are sketched.—E.S.L.

Johansen, D. *See* Danes, Z. F. 1750

Johnson, A. I. *See* Prill, R. C. 1596

1895 **Johnson, J. G.** Lower Devonian stratigraphy and correlation, northern Simpson Park Range, Nevada: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 365–381, 1965.

The uppermost beds of the largely Silurian Roberts Mountain Formation at Windmill Window are shown to be Early Devonian. The overlying Windmill Limestone (here proposed) contains interbedded graptolitic and shelly faunas, which indicate an Early Devonian (late Gedinnian or Siegenian) age; the distinctive brachiopod fauna is named the *Quadrithyris* zone. Also named is the *Spinoplasia*

zone, in the overlying Rabbit Hill Limestone, which is in turn overlain by the *Trematospira* zone at the base and the *"Spirifer" pinyonensis* zone at the top of the Lower Devonian McColley Canyon Formation.—C.A.S.

1553 **Johnson, J. Harlan.** Pennsylvanian and Permian calcareous algae [summ.], *in* Cong. Internat. Stratigraphie et Géologie Carbonifère, Paris, 1963, Compte Rendu, V. 2: Paris, Louis-Jean—GAP, p. 495–498, tables, 1964.

The writer refers to his comprehensive review (1963) which describes 44 genera with 74 species from the Pennsylvanian and 50 genera with 177 species from the Permian, in contrast to the much smaller number described by Julius von Pia (1937). The great increase in knowledge of a rather obscure field of micropaleontology largely reflects the demand by petroleum geologists for such, and the detailed studies of limestones sponsored by the petroleum industry. Tables show the classification and distribution of the various families and genera during the two periods, the predominant importance of the green algae, and the relatively small importance of calcified red algae. The Middle and Upper Permian show a surprising difference in flora, as well as the appearance of new reef-building forms.—G.D.C.

Johnson, J. O. *See* Barker, F. B. 1595

1942 **Johnson, James F.** Sinclair Dinoseis [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1762, 1965.

Johnson, R. K. *See* Hottman, C. E. 1899

Jones, M. H. *See* Danes, Z. F. 1750

1690 **Jopling, Alan V.** Geometrical properties of sand waves [discussion of paper 4055 by M. S. Yalin, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., Div., no. HY3, pt. 1, p. 348–360, illus., table, 1965.

Relative roughness data collated from various experiments are given. The tentative thesis is advanced that the transition stage, which corresponds to the washing out of the ripples or dunes, either begins or is underway when the characteristic jump is of such a length that the modal particle is deposited at or around the mid-slope position of the dune face.—E.S.L.

1592 **Jordan, Paul R.** Fluvial sediments of the Mississippi River at St. Louis, Missouri: U.S. Geol. Survey Water-Supply Paper 1802, 89 p.,illus., tables, 1965.

This report presents and interprets data on fluvial sediment and related hydraulic characteristics. Changes in concentration of suspended sediment, particle size of bed material, elevation of the streambed, and resistance to flow are principally influenced by changes in streamflow. Vertical distributions of velocity and sediment agree fairly well with theoretical laws and laboratory findings. Applicability of several equations for bedload discharge and bed-material discharge is investigated.—W.L.G.

Kah, J. S. *See* Nathans, M. N. 1567

Kane, M. F. *See* Pakiser, L. C. 1554

1577 **Kaplan, Stuart R.** (editor) Guides to information sources in science and technology—V. 2, A guide to information sources in mining, minerals, and geosciences: New York, Interscience Publishers, 599 p., illus., 1965.

This comprehensive volume emphasizes current and continuing sources of information in the fields of metallic and nonmetallic mining, metals, fuels, minerals, geology, geophysics, beneficiation and processing, geography, and the broad area of pure and applied earth sciences. Part 1 lists over 1,000 world-wide organizations in 142 countries, including details of addresses, description of purpose and function, organizational structure, branches, and publications. Part 2 lists over 600 world-wide publications and periodicals of various categories and fields of interest, arranged within each field by geographical areas.—G.D.C.

1806 **Keefer, William R.** Stratigraphy and geologic history of the uppermost Cretaceous, Paleocene, and lower Eocene rocks in the Wind River Basin, Wyoming: U.S. Geol. Survey Prof. Paper 495–A, p. A1–A77, illus., tables, geol. map, 1965.

The Wind River Basin, which covers 8,500 sq mi in central Wyoming, is one of the major sedimentary and structural basins formed in the Rocky Mountain region during Laramide deformation. The character and magnitude of sedimentation, and the type and timing of crustal movements in latest Cretaceous and early Tertiary times are described in this report.—W.L.G.

2130 **Keefer, William R.** Geologic history of Wind River basin, central Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1878–1892, illus., 1965.

The Wind River basin was part of the stable shelf that lay east of the Cordilleran geosyncline during Paleozoic and Mesozoic time. Sedimentary rocks representing all systems except possibly the Silurian are briefly described and related to the tectonic evolution of this region. The tectonic sequence culminated in the intense folding and faulting of the Laramide orogeny beginning in latest Cretaceous and extending into early Eocene time. The later Tertiary records basin filling, followed by late Pliocene and Pleistocene epeirogenic uplift that initiated a long period of degradation which still continues.—E.K.M.

1855 **Kelley, Vincent C.; Thompson, Tommy B.** Tectonics and general geology of the Ruidoso–Carrizozo region, central New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 110–121, illus., table, 1964.

The dominant structural element of this area is the broad Mescalero arch, composed of the Pect slope on the east, and declivities into the Claunch sag and Sierra Blanca basin on the west. Faults are of three principal types—large ones uplifting blocks, lesser ones modifying the blocks, and those which appear to be related to the Sierra Blanca basin. The tectonic history and regional relations are described from the early Paleozoic Sonoran geosyncline, through the emerging Pedernal landmass, Cretaceous subsidence, drier conditions due to the Laramide disturbances, to formation in the Tertiary of north–south arches and sags, followed by volcanism and intrusion. The tilted fault-block uplifts were the last to form, and uplift is still continuing. Structure sections and a tectonic map accompany the text.—E.S.L.

1909 **Kellough, Gene Ross.** Paleoecology of Foraminifera from the Wills Point Formation (Midway Group) in northeastern Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1753, 1965.

1720 **Kennedy, Vance C.** Mineralogy and cation-exchange capacity of sediments from selected streams: U.S. Geol. Survey Prof. Paper 433–D, p. D1–D28, illus., tables, 1965.

The mineralogy and cation-exchange capacity (CEC) of sediments from 21 streams in the United States were determined as part of a continuing investigation of the effect of sediments on the chemical composition of stream water. The sediments studied represent a great variety of geologic and climatic environments. The exchange capacity of stream sediments was found to range from rather low values in the humid southeast to rather high values in the semiarid west.—W.L.G.

Kent, Harry C. *See* Haun, John D. 2084

Kepferle, R. C. *See* Pohl, E. R. 1752

1843 **Kerr, J. W.; McGregor, D. C.; McLaren, D. J.** An unconformity between Middle and Upper Devonian rocks of Bathurst Island, with comments on Upper Devonian faunas and microfloras of the Parry Islands: Bull. Canadian Petroleum Geology, v. 13, no. 3, p. 409–431, illus., 1965.

The Griper Bay Formation is a widespread marine clastic deposit, which is of Late Devonian (Frasnian and Famennian) age, as indicated by assemblages of spores and marine invertebrates, largely brachiopods. On east Bathurst Island, it rests

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unconformably on folded Middle Devonian and older rocks indicating a hitherto unknown episode of deformation of the Boothia uplift and the Cornwallis fold belt in Middle to Late Devonian time. Information on the Upper Devonian faunas of the Canadian Arctic Islands is synthesized, and for the first time well-dated spore floras are described from this region.—C.A.S.

1790 **Kesling, Robert V.; Wright, Jean D** Two new Middle Devonian species of the starfish *Devonaster* from southwestern Ontario: Michigan Univ. Mus. Paleontology Contr., v. 20, no. 2, p. 49–61, illus., table, 1965.

Fossil starfish from the Middle Devonian Hamilton Group strata in Ontario are classified as two new species of *Devonaster*. *D. triradiatus* from the Arkona Shale, based on numerous specimens, is characterized by relatively small size, supramarginals set nearly above inframarginals, and a triradiate madrepore plate—the last an unusual and unique feature. *D. southworthi* from the Hungry Hollow Formation, based on one incomplete and weathered specimen, is characterized by large size, inframarginals wider than adambulacrals, and unusual shape of its second inframarginals.—Authors' abstract

Kilburn, Robert E. *See* Thurber, Walter A. 1576

1807 **King, Philip B.** Geology of the Sierra Diablo region, Texas, with special determinative studies of Permian fossils by L. G. Henbest, E. L. Yochelson, P. E. Cloud, Jr., Helen Duncan, R. M. Finks, I. G. Sohn: U.S. Geol. Survey Prof. Paper 480, 185 p., illus., tables, geol. maps, 1965.

The Sierra Diablo Range in western Texas is a plateau-like block mountain sloping gently westward from its crest and with abrupt escarpments on the east, north, and south. Oldest Precambrian rocks have been thrust across younger Precambrian sediments. Ordovician–Pennsylvanian rocks, folded and deeply eroded in Late Pennsylvanian, are overlain by Early Permian sediments with marked angular unconformity, and Cretaceous rocks overlie Permian and older rocks with marked unconformity. Sedimentary rocks of the Range are intruded by probable Tertiary igneous rocks. The present form developed during Cenozoic disturbances. Stratigraphic sections are given with fossil collections for Ordovician through Cretaceous strata. Economic resources are summarized.—V.S.N.

2126 **Kirkby, Anne V. T.** Boulder fields on Bald Eagle Mountain, Pennsylvania [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 626, 1965.

2075 **Kirkby, M. J.** Measurements of soil creep [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 626, 1965.

1706 **Kisch, H. J.** A study of medium-calcic plagioclase feldspars from coal-ash slags: Am. Mineralogist, v. 50, nos. 7–8, p. 1015–1028, illus., tables, 1965.

Medium to calcic plagioclase feldspars formed in slags possess structural states comparable to those of volcanic plagioclase. The positions of the optical indicatrix axes in a number of twinned individuals were measured on a universal stage. Comparison of the data with published figures and migration curves shows correspondence of the indicatrix orientations in the medium plagioclases (up to An_{65}) with the "high-temperature" curves; for the more calcic plagioclases from the slags, departures from these curves are evident, particularly with regard to the position of the Y indicatrix axes.—E.Z.

Kistler, James O. *See* Gallear, Yarrell C. 1935

1742 **Knop, Osvald; Ibrahim, M. A.** Satarno chalcogenides of the transition elements—[Pt.] 4, Pentlandite, a natural π phase: Canadian Mineralogist, v. 8, pt. 3, p. 291–316, illus., tables, 1965.

Pendlandite must be regarded as a natural π (Fe,Co,Ni,S) phase in which the Fe:Co:Ni ratio may vary within wide limits. The problem of the "true" Ni:Fe ratio is meaningless. The same holds for the lattice parameter, though all the classical, i. e., low-cobalt, pentlandites have been found to have a parameter between

10.034 and 10.067 A. When natural pentlandite is heated in vacuo or in argon its lattice parameter increases by about 1/2 of one percent. The expansion of the unit cell, which takes place between 150 and 200°C, is not prevented by argon pressures up to 2,000 atm.—from authors' abstract

2032 **Kohn, J. A.; Eckart, D. W.** Mixed-layer polytypes related to magnetoplumbite: Am. Mineralogist, v. 50, no. 9, p. 1371–1380, illus., tables, 1965.

Thirteen new, discrete rhombohedral and hexagonal layer structures, of the type $Ba_uZn_vFe_wO_z$, have been identified. They consist of an ordered *c*-axis stacking of two five-anion-layer substituted magnetoplumbite units (M) with a variable number of closely related six-layer units (Y). An M_2Y_n series (n = 1–10) is generated, in which all unit cells have a common basal section and hexagonal *c* varies up to 505.4A. For a given M_2:Y_n ratio, mixed-layer polytypes form by permutation of the M and Y units along *c*. Diffractometer traces, OO.*l*, furnished relative intensities for use with one-dimensional structure-factor calculations to establish stacking structures from among qualifying models.—E.Z.

1918 **Kolb, Charles R.; VanLopik, Jack R.** Depositional environments of Mississippi River deltaic plain—Southeastern Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1755, 1965.

1873 **Kottlowski, Frank E.** Sedimentary framework of the pre-Cenozoic rocks in southwestern New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 187, 1964.

2136 **Kottlowski, Frank E.** Sedimentary basins of south-central and southwestern New Mexico: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 2120–2139, illus., 1965.

Southwestern New Mexico has scattered shelf deposits of Middle Cambrian, Ordovician, Lower and Middle Silurian, and Upper Devonian. During Mississippian time the Caballero, Pedregosa, and Orogrande basins began to develop. After an erosional period Pennsylvanian beds were deposited in these and the San Mateo and Lucero basins. Orogrande basin ended after deposition of Wolfcampian beds. During mid-Permian small local evaporite basins developed scattered in a shallow epicontinental sea which was periodically flooded by redbed detritus from the north. Some Triassic redbeds were deposited. In Early Cretaceous, sediments were deposited in the southwest with volcanics in the southwesternmost part. Upper Cretaceous strata covered most of the area. There is no petroleum production to date but shows are reported in Otero County.—S.P.S.

1837 **Kozak, Samuel J.** Geology of the Millboro quadrangle, Virginia: Virginia Div. Mineral Resources Rept. Inv. 8, 19 p., table, geol. map, 1965.

Cambrian-Ordovician rocks outcrop in the southeast and Silurian-Devonian in the northwest. They have an aggregate thickness of 15,000 feet. Deformation can be dated only as post Chemung, and is more intense to the southeast. Limestone and dolomite, silica sand from sandstones, and clay are the only potentially valuable products.—E.S.L.

1943 **Kramer, F. S.; Swan, M. L.** High-speed digital correlator for geophysical application [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1762, 1965.

Kvale, A. *See* Hodgson, J. H. 2123

1755 **LaFehr, T. R.** Gravity, isostasy, and crustal structure in the southern Cascade Range: Jour. Geophys. Research, v. 70, no. 22, p. 5581–5597, illus., table, 1965.

Gravity anomalies suggest that (1) a large volume of low-density material exists at shallow depth beneath the High Cascades. (2) The free-air anomaly in the Interior Platform region averages nearly zero, therefore, this area must be nearly isostatically compensated. (3) The negative gravity anomaly associated with the High Cascades

near and including Mount Shasta indicates a mass deficiency of 4.0×10^{17}g, corresponding well with the mass excess of the range and suggesting that the High Cascades are compensated. (4) The negative gravity anomaly at Mount Shasta indicates a mass deficiency of 5.4×10^{17}g, corresponding well with the mass excess of the mountain; its isostatic compensation must be in large part local.—D.B.V.

1944 **Lane, N. Gary.** Stratigraphic evidence for Las Vegas Valley shear zone [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1762–1763, 1965.

1729 **Laporte, Léo F.** Evolution as a geologic concept—An introductory geology course: Jour. Geol. Education, v. 13, no. 4, p. 115–116, 1965.

A rather radical two-year course in geology has been introduced at Brown University. The goal is to present the kinds of questions geologists pose regarding the origin, composition, development and history of the Earth; the methods, logical as well as technical, for solution; the nature of geological evidence; and some of the ideas and concepts that are currently important.—E.S.L.

1678 **Larson, Lawrence T.; Barnes, Robert H.** Mineral resources summary of the Dover quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 12 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 29-NE and describes the iron ore, limestone and gravel resources of the Dover quadrangle. Although iron ore has been produced from several locations, none has been mined since 1927 because of excessive transporation costs. Most of the deposits are on or near the crests of ridges or on ridge spurs, and are preserved on and under the post Mississippian erosional surface. Limestone is available in the Warsaw, St. Louis, and Fort Payne Formations, but only the Warsaw (maximum thickness 180 feet) has been quarried. Three gravel pits have been excavated, but all are now depleted and abandoned; gravel resources in the Tuscaloosa appear to be substantial, although the known pits are depleted. Potential resources are chert and sand.—M.C.M.

1732 **Larson, Lawrence, T.** Mineral resources summary of the Bumpus Mills quadrangle, Tennessee (including the Tennessee portion of the Johnson Hollow quadrangle, Kentucky–Tennessee): Nashville, Tennessee Div. Geology, 17 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 28-SE and describes the iron ore, limestone, and sand and gravel resources in the Bumpus Mills quadrangle. Only minor amounts of iron ore have been mined on or near crests of ridges which are underlain by flat-lying, siliceous limestone and cherts of the Mississippian St. Louis, Warsaw, and Fort Payne Formations. The Warsaw is the best source of limestone but thick overburden creates problems in developing a quarry. Sand and gravel are present as alluvial channel fill and bar deposits of recent age, and as lenses and pools of Tuscaloosa Gravel of Cretaceous age which cap many of the ridges. Lithologic logs are included.—M.C.M.

1566 **Lathram, E. H.; Pomeroy, J. S.; Berg, H. C.; Loney, R. A.** Reconnaissance geology of Admiralty Island, Alaska: U.S. Geol. Survey Bull. 1181-R, p. R1–R48, illus., tables, geol. map, 1965.

Admiralty Island, one of the major islands of the Alexander Archipelago, lies adjacent to the Alaskan mainland south of Juneau. The layered rocks consist of marine argillite, graywacke, andesitic and basaltic volcanic rocks, limestone, chert and conglomerate of Silurian(?), Devonian and Devonian(?), Permian, Late Triassic, and Late Jurassic and Early Cretaceous age, and continental volcanic flows and coal-bearing siltstone, sandstone and conglomerate of Paleocene through Miocene age. Between Early Cretaceous and Paleocene times, the rocks were folded at least twice, metamorphosed, faulted, and intruded by igneous rocks, mostly of intermediate composition. Additional faulting occurred after Miocene time.—W.L.G.

Laudelout, H. *See* Gilbert, M. 1814

2076 **LaValle, Placido.** Some spatial aspects of linear karst depression development in southcentral Kentucky [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 628, 1965.

Leet, Florence J. *See* Leet, L. Don. 1561

1561 **Leet, L. Don; Leet, Florence J.** Explanation for surface wave duration: Earthquake Notes, v. 36, nos. 1–2, p. 1–6, illus., 1965.

In 1962 some multiple megaton devices detonated at high altitudes over Novaya Zemlya started surface waves which were recorded more than a sixth of the way around the world. The distances and azimuths of these recorded waves, listed herein, were computed at the Massachusetts Institute of Technology, and traveltimes of the vertical component crest of each of the first 15 waves were plotted against distance. The data seem to support the hypothesis that duration of surface waves results from an oscillating source and that these surface waves are transmitted with attenuation which causes each period to increase with distance of travel. Under such conditions, concepts such as group velocity or velocity of a given period lose physical meaning.—G.D.C.

1975 **Leith, E. I.** Stony Mountain Shale Member or Gunn Member?: Bull. Canadian Petroleum Geology, v. 13, no. 1, p. 192–193, 1965.

The validity for the name Gunn Member to replace the name Stony Mountain Shale Member for the basal unit of the Stony Mountain Formation [Upper Ordovician] of Manitoba is discussed.—Author's abstract

LePichon, Xavier. *See* Talwani, Manik. 1834

1945 **Lessard, Robert H.** Intertidal and shallow-water Foraminifera of tropical Pacific Ocean [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1763, 1965.

2133 **Lessentine, Ross H.** Kaiparowits and Black Mesa basins—Stratigraphic synthesis: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1997–2019, illus., 1965.

During Paleozoic and Mesozoic time the Kaiparowits and Black Mesa basins (Colorado Plateau) occupied a northwest-trending structural trough across the shelf between the Cordilleran geosyncline and the transcontinental arch. Periodic sags allowed deposition of Cambrian, Devonian, Mississippian, Pennsylvanian, and Permian marine sediments. Upper Permian red beds and eolian sandstone are overlain by transgressive-phase carbonates; Mesozoic sediments consist mainly of red beds and eolian sandstone. Complex Permian and Mesozoic facies changes and abrupt stratigraphic terminations may prove to be traps for oil accumulation. The bibliography is comprehensive.—B.H.K.

1556 **Lewis, George Edward; Vaughn, Peter Paul.** Early Permian vertebrates from the Cutler Formation of the Placerville area, Colorado: U.S. Geol. Survey Prof. Paper 503-C, p. C1–C50, illus., table, 1965.

New discoveries of vertebrates in the Cutler Formation near Placerville show the age of the formation to be Early Permian, comparable to that part of the Dunkard Group and part of the Wichita Group (Moran, Putnam, and Admiral Formations) of the United States, and to that of the Autunian and lower Rotliegende of Europe. Two genera of labyrinthodont amphibians, four of cotylosaurian reptiles, and three of pelycosaurian reptiles were found. Two new genera and two new species are described and named.—V.S.N.

1946 **Lidz, Louis.** Planktonic Foraminifera in water column, Newport Submarine Canyon [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1763, 1965.

Linden, N. A. *See* Hodgson, J. H. 2123

1735 **Lindquist, Erik G. W.** Turbulent flow in porous media [discussion of paper 4019 by J. C. Ward, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 325–330, illus., table, 1965.

The results of five experiments on the flow of water through beds of uniform lead shot are compared with Ward's experiment. The agreement seems to be good.—E.S.L.

1897 **Lipps, Jere H.** Miocene planktonic Foraminifera from near Newport Beach, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1764, 1965.

1947 **Lipps, Jere H.** Foraminiferal family Pseudoparrellidae Voloshinova [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1763–1764, 1965.

2105 **Lipps, Jere H.** Oligocene in California?: Nature, v. 208, no. 5013, p. 885–886, table, 1965.

Planktonic Foraminifera indicative of the Oligocene *Globigerina oligocaenica* zone of Eames and others (1962) have been found in rocks assigned previously to the Zemorrian stage of the California "Miocene". This fauna clearly established the presence of Oligocene marine sediments in California, contrary to previous implications and statements. Together with the established presence of this zone in the Gulf Coast region, these results suggest that widespread uplift, resulting in non-deposition in these parts of America, did not occur in the Oligocene.—D.B.V.

2044 **Lipschutz, Michael E.** Origin of atypical meteorites from the Arizona Meteor Crater: Nature, v. 208, no. 5011, p. 636–638, illus., 1965.

Four explanations have been advanced to account for the atypical samples of the Canyon Diablo meteorite. Detailed study of the shock-induced metallographic changes in samples of Canyon Diablo No. 2 and No. 3 suggests that these were locked in the interior of the meteoroid during the instant of its explosion and were, therefore, neither satellites of the main mass nor separate later falls. No absolute conclusions could be reached concerning the origin of the Monument Rock sample. It seems reasonable to regard as proved the suggestion that chemical and structural variations do exist in iron meteorites over distances of less than 100 m (Heymann, 1964).—D.B.V.

1887 **Lochman-Balk, Christina.** Lexicon of stratigraphic names used in Lincoln County, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 57–61, 1964.

This is an alphabetical listing and brief discussion of the stratigraphic names that have been used in the County, for units that are Pennsylvanian through Quaternary in age.—E.S.L.

1898 **Loep, Kenneth J.** Study of ecology and distribution of Recent Foraminifera in northwestern Gulf of Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1753–1754, 1965.

Loleit, Allan J. *See* Peterson, James A. 2116

Loney, R. A. *See* Lathram, E. H. 1566

Longshore, Judith C. *See* Rogers, John J. W. 1911

1700 **Lovell, H. L.** (and others) Powell township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P.272, scale 1 in to 1/4 mi, text, 1965.

The geology of Powell township is covered generally by the text for Map 273, also by Lovell (1965). Of economic interest are gold and associated minerals, molybdenum, chalcopyrite, copper, nickel, and asbestos.—M.C.M.

1715 **Lovell, H. L.** (and others) Cairo township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P.273, scale 1 in to 1/4 mi, text, 1965.

Cairo township contains rocks of every major Precambrian stratigraphic unit of northeastern Ontario. "Greenstones", forming the bedrock of one-third of the area, are overlain by tightly folded sedimentary rocks. Acid intrusive rocks form most of the bedrock in the eastern half of the township. Sedimentary rocks, mostly flat-lying, trending northeast, consist mainly of interbedded conglomerate, argillaceous quartzite, and arkose. This is the type area for Matachewan diabase dikes which form north-trending ridges. Most of the overburden is glacial drift. Several faults, shear zones, and topographic lineaments are present in the area. Minerals of economic interest are gold, fluorite, barite, and asbestos.—M.C.

1841 **Lowe, R. H.; Massey, H. F.** Hot water extraction for available soil molybdenum: Soil Sci., v. 100, no. 4, p. 238–243, 1965.

A new method of determining available soil Mo, using hot water as an extractant, is described. For either wooded or cultivated soils, the hot-water method appeared to be a much more reliable method of extracting available Mo than the Grigg method.—J.W.H.

1670 **Lowman, Paul D., Jr.** Non-anatectic migmatites in Gilpin County, Colorado: Geol. Soc. America Bull., v. 76, no. 9, p. 1061–1064, illus., table, 1965.

Modal analyses and field studies of extensively migmatized biotite gneisses fail to substantiate an anatectic origin for Gilpin County migmatites. Derivation from pegmatite dikes is indicated in many cases.—J.J.H.

2088 **Lowrie, L. M.; Mickey, W. V.** Project DUGOUT—Strong-motion seismic measurements: U.S. Atomic Energy Comm. Final Rept. PNE-605F, 41 p., illus., tables, 1965.

Strong-motion seismograph data from the 100-ton DUGOUT row charge cratering experiments are discussed. The experiments were monitored, at distances from 146–1.58 m, for the purpose of determining any azimuthal variation in propagation of seismic energy dependent upon configuration of the charge. Symmetrical seismic wave propagation was indicated beyond 250 m. For stations on the two recording lines at a distance of 1.5 km, particle motion diagrams and spectrograms showed no dissimilarities that could be correlated with charge. At 600 m, Fourier spectrograms showed more high frequency content in line with the charge. First motion traveltimes of 2.2 kmps were not in accord with laboratory determinations of velocities between 3.5 and 4.5 kmps for the basalt of Buckboard Mesa. This is attributed to inhomogeneities in the basalt.—V.S.N.

1575 **MacCary, L. M.** Availability of ground water in the Birmingham Point quadrangle, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-159, scale 1:24,000, section, text, 1965.

The most important aquifers in the Birmingham Point quadrangle are the Tuscaloosa Formation (Cretaceous) and the Paleozoic limestones with their associated residual chert rubble; the McNairy Formation and alluvium are of less consequence. Several small springs issue from the Warsaw and the St. Louis Limestones along tributaries of the Cumberland River south of Boyds Landing. Water from the main aquifers is soft or moderately hard, slightly acidic, and usually contains iron in objectionable amounts. The map sheet includes a columnar and a geologic section, and a table showing analysis of the water.—M.C.M.

1948 **MacDonald, Gordon J. F.** Deep structure of continents [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1764, 1965.

Mackay, J. R. *See* Mathews, W. H. 2007

MacKevett, E. M., Jr. *See* Sainsbury, C. L. 1882

MacMahon, Brian. *See* White, Cedric Masey. 1692

1967 **Macurda, Donald B., Jr.** *Orbiblastus*, a new Mississippian blastoid genus from Arkansas: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 299–307, illus., 1965.

The specimen was found in a residual chert mantle on Mississippian limestone in Marion County. A systematic description is given, along with a brief description of two specimens of *Hadroblastus* found in the same location.—E.S.L.

Madden, T. R. *See* Brace, W. F. 1580

Mahoney, Leona R. *See* Harker, Peter. 1664

1810 **Maiklein, W. R.; Campbell, F. A.** A study of the clays from Upper Cretaceous bentonites and shales in Alberta: Canadian Mineralogist, v. 8, pt. 3, p. 354–371, illus., tables, 1965.

Four bentonite and two shale samples from the Upper Cretaceous Belly River Formation at Bow River near Calgary were studied by X-ray spectrochemical analyses and by Fourier analyses of the clay minerals. Little difference obtains in the chemical compositions of the bentonites and of the shales. The relative amounts of different clay minerals of the bentonites may be diagnostic of the bentonites and useful for correlation; these clay minerals include mixed-layer clays of vermiculite/montmorillonite/illite layers showing tendency to long-range ordering. In the shales, mixed-layer clays are absent but kaolinite is more important.—E.Z.

Malfait, B. *See* Danes, Z. F. 1750

Maloney, Neil J. *See* Byrne, John V. 1924

1949 **Maloney, Neil J.; Byrne, John V.** Offshore Oregon—Some notes on petrography and geologic history [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1764, 1965.

1890 **Mandarino, J. A.; Harris, D. C.** New Canadian mineral occurrences—[Pt.] 1, Eucryptite, pollucite, rozenite, epsomite, dawsonite, fairchildite, and butschliite: Canadian Mineralogist, v. 8, pt. 3, p. 377–381, tables, 1965.

Short notes are given on new occurrences of various mineral species in Canada. Index X-ray diffraction powder data are tabulated for dawsonite.—M.L.L.

1694 **Marcher, Melvin C.** Geologic map of the Dover quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 29-NE, scale 1:24,000, separate text, 1964 [1965].

The text, "Mineral resources summary of the Dover quadrangle, Tennessee," by L. T. Larson and R. H. Barnes is cited separately.—M.C.M.

1695 **Marcher, Melvin V.** Geologic map of the Bumpus Mills quadrangle, Tennessee (including the Tennessee portion of the Johnson Hollow quadrangle, Kentucky-Tennessee): Tennessee Div. Geology Geol. Map GM 28-SE, scale 1:24,000, separate text, 1964 [1965].

The text, "Mineral resources summary of the Bumpus Mills quadrangle, Tennessee . . .," by L. T. Larson is cited separately.—M.C.M.

1733 **Marcher, Melvin V.; Finlayson, C. Pratt.** Geologic map of the Charlotte quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 48-NE, scale 1:24,000, separate text, 1964 [1965].

The text, "Mineral resources summary of the Charlotte quadrangle, Tennessee," by J. M. Colvin, Jr., and D. S. Fullerton is cited separately.—M.C.M.

2066 **Margolis, Stanley.** Quartz sand surface textures as an indicator of shoreline energy levels: Coastal Research Notes, no. 11, p. 13–15, 1965.

Grains were collected from the surf zone on seven beaches, four of them in Florida. Observations have shown that where there is low breaker energy, chemical solution is the major process, causing oriented etch pits; where breaker height is moderate to high, mechanical action is dominant, producing breakage blocks and percussion marks. The overall relief of grains is also an indicator and grains above one mm in size are better indicators.—E.S.L.

Marine, I. W. *See* Diment, W. H. 1749

1912 **Marquis, G. L.; Wichmann, P. A.; Millis, C. W.** Studies of producing reservoirs with Neutron Lifetime Log [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1754, 1965.

Marshall, L. C. *See* Berkner, L. V. 2034

1950 **Martin, Bruce D.** Monterey Submarine Canyon, California—Genesis and relationship to continental geology [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1764, 1965.

2131 **Martin, Charles A.** Denver basin: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1908–1925, illus., 1965.

The Denver basin is a large asymmetric basin in Colorado, Nebraska, and Wyoming that contains a maximum of more than 13,000 feet of sediments of Paleozoic and Mesozoic age. During the Paleozoic and early Mesozoic eras normal marine and evaporitic sediments were deposited. In late Mesozoic time, deltaic deposits interfingered with normal marine deposits, and the present form of the basin emerged. The "D" and "J" sandstones of Cretaceous age are prolific producers of oil and gas.—W.C.C.

Martin, Charles W. *See* Gooding, Ansel M. 1731

1718 **Martin, Edgar Keith.** Biostratigraphy of the Upper Pennsylvanian Wayland Shale in McCulloch-Coleman Counties, central Texas [abs.]: Houston Geol. Soc. Bull., v. 8, no. 3, p. 19–20, 1965.

Martin, K. G. *See* Moore, C. H., Jr. 1906

1782 **Martins, L. R.** Significance of skewness and kurtosis in environmental interpretation: Jour. Sed. Petrology, v. 35, no. 3, p. 768–770, illus., 1965.

Statistical measures of their grain-size distributions differentiate beach and dune sands of the Rio Grande do Sul coastal plain in Brazil, confirming conclusions of Mason and Folk (1958) and Friedman (1961).—R.A.C.

Massey, H. F. *See* Lowe, R. H. 1841

Masten, J. *See* Danes, Z. F. 1750

2068 **Mather, Tom.** Electron microscopy of terrace deposits and modern coastal sands: Coastal Research Notes, no. 11, p. 22–23, 1965.

It has been indicated that the 170-ft terrace preserved in Gadsden and Liberty Counties, Fla., represents an ancient barrier island and lagoon. The configuration of this terrace is very similar to the modern barrier island and lagoon of St. George Island and St. George Sound. Photomicrographs reveal that surface features found on the sand grains from the terrace compare favorably with those characteristic of the modern barrier island and lagoon.—E.S.L.

2007 **Mathews, W. H.; Mackay, J. R.** Ice-pushed ridges, permafrost, and drainage—A reply [to discussion of 1964 paper by M. G. Rutten, 1965]: Jour. Geology, v. 73, no. 6, p. 896, 1965.

The authors note a misunderstanding by Rutten (ibid., p. 895–896) and reiterate their belief that permafrost plays a role in ice-thrust phenomena. They differ in

their view of the circumstances under which the permafrost developed. Ponding as a result of damming along ice fronts has been both implied and stated by previous authors. Regardless of terminology, damming would create a heat accumulator, which would degrade permafrost. It is suggested that waterlogging is not necessary for permafrost, because normal water content is high enough to provide adequate bonding by ice.—D.R.M.

1816 **Matsusaka, Y.; Sherman, G. D.; Swindale, L. D.** Nature of magnetic minerals in Hawaiian soils: Soil Sci., v. 100, no. 3, p. 192–199, illus., 1965.

Both titanomagnetite and titanomaghemite were found in Hawaiian soils with the former occurring primarily in weakly weathered and continuously wet soils. Most of the titanomaghemite is formed by oxidation of titanomagnetite present in Hawaiian basaltic and andesitic rocks. The titanomagnetite seems to contain between 21 and 25 mole percent TiO_2. Some of the titanomaghemite in the highly weathered soils may be formed by the dehydration of lepidocrocite in the presence of Ti^{4+} ions.—J.W.H.

1712 **Maxey, George B.; Domenico, Patrick A.; Stephenson, David A.** Hydrogeology and hydrology, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p.60–90, App. p. 118–147, illus., tables, 1964 [1965].

Studies were made of granite in the Sand Springs Range and alluvium in the adjacent valleys to determine whether water contamination might result from the Project Shoal underground nuclear explosion in the granite. Granitic rocks contain some ground water but act more as barriers which neither transmit nor store water. Alluvial deposits contain more aquifers but because of the fairly uniform permeability of the fill and the low gradients, velocity of water movement is very slow. Assuming that the nuclear detonation is fully contained, test hole and well data indicate that the granite and the alluvial fill would rapidly fix the radionuclides within a short distance of the range front.—M.C.

McClure, William L. *See* Slaughter, Bob H. 2113

McGregor, D. C. *See* Kerr, J. W. 1843

2078 **McIntire, W. G.; Russell, R. J.** Correlation of coral reef structure with Pleistocene sea levels [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 632, 1965.

McIntire, William G. *See* Russell, Richard J. 2080

1669 **McIntyre, D. B.; Welday, E. E.; Baird, A. K.** Geologic application of the air pycnometer—A study of the precision of measurement: Geol. Soc. America Bull., v. 76, no. 9, p. 1055–1060, illus., table, 1965.

Specific gravity of weighed specimens can be obtained by volume displacement of air with a precision of 0.003 to 0.004 standard deviation. Contoured trend surfaces of specific gravity, iron, Q-mode vector analysis, and normative quartz are presented for granitic rocks of the San Bernardino Mountains, southern California.—A.G.

McIntyre, L. B. *See* Ohlen, H. R. 2134

1563 **McKee, Edith M.** Geology on the air: Geotimes, v. 10, no. 3, p. 22, 1965.

The Chicago area now has a radio series to help explain what earth science is and how it affects the way people live. The program, *Geology and you*, carried weekly during the school year, discusses current news items with geological factors, and includes interviews with guests such as lawyers, bankers, builders, librarians, economists, and a biochemist, about the application of geology to their particular business.—G.D.C.

McLaren, D. J. *See* Kerr, J. W. 1843

2125 **McMannis, William J.** Résumè of depositional and structural history of western Montana: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1801–1823, illus., 1965.

The western part of Montana lies partly in the shelf region and partly in the marginal area of the Cordilleran geosyncline. Sedimentary history began with deposition of the late Precambrian Belt Series, which occupies the northwestern part of the area. Cambrian through Mississippian formations and parts of the Cretaceous section are typically thicker in zones underlain by thick sequences of Belt rocks. In general, Triassic, Permian, Pennsylvanian, and Mississippian formations successively underlie Jurassic beds from south to north due to southward tilting and beveling during pre-Jurassic erosion.—A.E.R.

Mehlich, A. *See* Visser, S. A. 1817

1738 **Merriam, Richard.** San Jacinto fault in northwestern Sonora, Mexico: Geol. Soc. America Bull., v. 76, no. 9, p. 1051–1054, illus., 1965.

Pleistocene and Recent delta sediments east of the mouth of the Colorado River are cut by a zone of faults believed to be a continuation of the San Jacinto fault of California. The northeast side is elevated and a small amount of right-lateral displacement has occurred.—A.G.

1951 **Merriam, Richard H.** Source of Palm Spring sediments, Imperial Valley, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1764–1765, 1965.

2013 **Merrihue, Craig; Turner, Grenville.** The origin of anomalous Xe-129 in meteorites: Zeitschr. Naturforschung, v. 20a, no. 7, p. 961–962, 1965.

Four lines of evidence are invoked to show that anomalous Xe-129 in meteorites could not arise from incomplete mixing of Xe-129 formed by decay of I-129 in the solar nebula prior to formation and cooling of the meteorite solids, but rather must have originated from the decay of I-129 within the meteorite itself.—D.B.V.

Merritt, Clifford A. *See* Ham, William E. 1560

1787 **Merritt, Paul C.** Mesabi enters a new era: Mining Eng., v. 17, no. 10, p. 93–108, illus., tables, 1965.

The rapid growth of the taconite industry in Minnesota during the past year has been characterized by numerous announcements of newly proposed plants or the expansion of those already existing on the Mesabi Range. In a series of updating reports, the essential aspect of each plant is described with emphasis on the mining and processing methods now envisioned. Also summarized are the economic outlook for Minnesota taconite and the important role played by the Taconite Amendment which brought these new developments about.—Mining Eng. abstract

1741 **Meyerhof, George G.** Stability of slopes in anisotropic soils [discussion of paper 4405 by K. Y. Lo, 1965]: Am. Soc. Civil Engineers Proc., v. 91, paper 4525, Jour. Soil Mechanics and Found. Div., no. SM6, pt. 1, p. 132, 1965.

The greater the anisotropy of the soil, the more the potential failure surface will become elongated in the direction of the smaller shear strength.—E.S.L.

Mickey, W. V. *See* Lowrie, L. M. 2088

1812 **Middleton, K. R.** Determination of aluminum and iron, and the relation of aluminum to clay in certain tropical soils: Soil Sci., v. 100, no. 5, p. 361–367, illus., 1965.

A rapid method is described for determining Fe and Al in soils through measurements of the optical densities of their metallic hydroxquinolinates. The amounts of Fe and Al extracted from Malayan soils correlated very significantly

with pH in the extracting solution. Ferric ions probably do not exist in soil solution above pH 2.2 and Al ions are probably absent above pH 4.7.—J.W.H.

Mifflin, M. D. *See* Domenico, P. A. 1722

2037 **Miles, Roger S.** On some coccosteomorph arthrodires from the Devonian of Arizona: Arkiv Zoologi, v. 16, pt. 5, no. 22, p. 427–460, illus., 1965.

The coccosteomorph from Mt. Elden which Hussakof named *Coccosteus arizonensis* is redescribed. An interior lateral plate of this species, from a new locality on the south side of Mt. Mingus, Arizona, is described also. This coccosteomorph can no longer be retained within the genus *Coccosteus*, and a new genus, *Eldenosteus*, is proposed. Short descriptions are included for several large, tuberculated coccosteomorph plates from the same localities. Photographs and drawings accompany the article.—E.S.L.

2038 **Miles, Roger S.** A large arthrodire plate from Chautauqua County, New York: Arkiv Zoologi, v. 16, pt. 6, no. 28, p. 545–550, illus., 1965.

The large but incomplete median dorsal plate, no. UF 101 in the Chicago Natural History Museum, is described. It is Upper Devonian in age and is probably from the Chadakoin Formation. The writer suggests that the specimen described be known as *Aspidichthys?* sp. for the present time. The confusion over the name *Aspidichthys* is discussed. The description of the new specimen may mean that here is another case of an arthrodire genus common to Europe and North America.—E.S.L.

Millis, C. W. *See* Marquis, G. L. 1912

1827 **Milton, Charles.** Note on the occurrence of eudialyte in Canada: Canadian Mineralogist, v. 8, pt. 3, p. 382–383, 1965.

Material first described as eucolite (eudialyte) from Egan Chute, York River, Ontario, has subsequently been identified as zircon.—M.L.L.

1784 **Moberly, Ralph, Jr.; Baver, L. D., Jr.; Morrison, Anne.** Source and variation of Hawaiian littoral sand: Jour. Sed. Petrology, v. 35, no. 3, p. 589–598, illus., 1965.

Hawaiian beach deposits include both detrital and organic sand. Relative abundance of each type depends on recency of volcanism, intensity of weathering near source and vigor of growth of marine organisms. Size and sorting of particles depend on exposure to tradewind-driven waves, storms and reef configuration. Detrital grains are chiefly basalt but locally include much olivine or basalt glass. Organic grains are from Foraminifera, mollusks, red algae, echinoids, corals and *Halimeda*.—E.D.M.

Moll, W. F., Jr. *See* Brindley, G. W. 2033

2100 **Monkhouse, F. J.** A dictionary of geography: Chicago, Ill., Aldine Publishing Co., 344 p., illus., tables, 1965.

In compiling the 3,400 entries for this dictionary, the main criterion for inclusion has been usage. Foreign words are listed where they have been accepted into English geographical literature. The emphasis throughout is on specific factual information, rather than bare definition. Main categories of entry of interest to geologists are: landforms, oceanography, Earth as a spheroid, and soil. Statistical material and formulae are appended under relevant entries, and 224 diagrams are included as an integral part of the text.—E.S.L.

1550 **Monty, Claude.** Recent algal stromatolites in the windward lagoon, Andros Island, Bahamas: Soc. Géol. Belgique Annales 1964–65, v. 88, Bull. nos. 5–6, p. 269–276, illus., 1965.

Cryptozoon and collenia-like stromatolitic colonies of blue-green algae range from the intertidal zone to depths of 2 meters at low tide, in the windward lagoon of Andros Island. The internal structure consists of superposed hemispheroidal laminae of gel, or of laminae alternately rich and poor in entrapped particles of calcium carbonate. This lamination is noctidiurnal and controlled by a metabolic cycle of the algal colonies.—Author's abstract

1906 **Moore, C. H., Jr.; Martin, K. G.** Comparison of quartz and carbonate shallow-marine sandstones, Cretaceous Fredericksburg, central Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1751-1752, 1965.

1800 **Moore, Gerald K.** Geology and hydrology of the Claiborne Group in western Tennessee: U.S. Geol. Survey Water-Supply Paper 1809-F, p. F1-F44, illus., tables, 1965.

The area of western Tennessee underlain by the Claiborne Group is about 7,200 sq mi and lies on the east flank of the syncline that forms the Mississippi embayment. This report (1) defines the limits of the water-bearing zones in the Claiborne Group, (2) explains the hydrogeologic functions of these aquifers, (3) describes the chemical quality of water contained in them, and (4) determines the effects of past and future development on the overall adequacy of the water supply. Brief descriptions of the geography and geology of the area are given.—W.L.G.

1896 **Moore, Neil A.** *Electro-Sonic Profiler* [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1765, 1965.

2012 **Moore, Paul B.; Ribbe, Paul H.** A study of "calcium-larsenite" renamed esperite: Am. Mineralogist, v. 50, no. 9, p. 1170-1178, illus., tables, 1965.

Single crystal studies of "calcium-larsenite", (Ca, Pb)$ZnSiO_4$, from Franklin, N. J., show that it is not directly related to larsenite, $PbZnSiO_4$, although both are tecto-zincosilicates. It is monoclinic with $a=2\times8.814$, $b=8.270$, $c=2\times15.26$A, $\beta=90°$. The space group of the basic unit cell is $P2_1/n$; but supperlattice reflections, presumed due to Ca/Pb ordering, effectively double the a- and c-axes, making the superstructure B-face centered. Marked structural similarities to beryllonite and trimerite are observed. . . Luminescence and decomposition with heating are of particular interest. "Calcium-larsenite" has been renamed *esperite* for Prof. Esper S. Larsen, Jr.—Authors' abstract

Morgan, J. R. *See* DeLisle, Mark, 1671

1759 **Morgan, R. E.** Memorial to Oliver Rudolph Grawe (1901-1965): Jour. Geol. Education, v. 13, no. 4, p. 124-125, 1965.

1764 **Morgan, W. Jason.** Gravity anomalies and convection currents—Pt. 1, A sphere and cylinder sinking beneath the surface of a viscous fluid: Jour. Geophys. Research, v. 70, no. 24, p. 6175-6187, illus., 1965.

Examination of the effects of a sphere and cylinder sinking beneath the surface of a viscous fluid shows that the horizontal divergence of the velocity at the surface of the fluid is related to the measured free-air anomaly if the viscosity of the fluid is uniform, and the vertical load supported at the surface (F_{zz}) is essentially independent of any vertical variation of the viscosity of the fluid, and also of the boundary conditions of the top surface. A two-layer fluid model is examined, and it is found that F_{zz} is relatively independent of the thickness of the top layer or the ratio of the two viscosities, especially if the top layer has the greater viscosity. Whereas horizontal velocity at the surface is very dependent on the assumed viscosity pattern, F_{zz} is not; this makes it possible to find the approximate mass of a sinking body and its depth beneath the surface independently of the viscosity pattern of the Earth.—D.B.V.

1765 **Morgan, W. Jason.** Gravity anomalies and convection currents—Pt. 2, The Puerto Rico Trench and the Mid-Atlantic Rise: Jour. Geophys. Research, v. 70, no. 24, p. 6189-6204, illus., 1965.

The results found in the first part of this work are applied to the Earth. The vertical surface load is related to the thickness of the crustal layers, and the net free-air anomaly is caused by the attraction of the deep sinker. The crustal thickness and free-air anomaly computed for sinkers of different sizes and depths are compared with the measured free-air anomalies and seismic depths of the Puerto Rico Trench and Mid-Atlantic Rise; in both cases the driving mass has an optimum depth of about 100 km. In Puerto Rico the driving mass is very concentrated at this depth, whereas in the mid-Atlantic it is more diffuse.—D.B.V.

Morris, D. A. *See* Prill, R. C. 1596

Morris, H. T. *See* Roberts, Ralph J. 2051

Morrison, Anne. *See* Moberly, Ralph, Jr. 1784

1745 **Morrison, R. B.; Frye, John C.** Correlation of the middle and late Quaternary successions of the Lake Lahontan, Lake Bonneville, Rocky Mountain (Wasatch Range), southern Great Plains, and eastern Midwest areas: Nevada Bur. Mines Rept. 9, 45 p., illus., tables, 1965.

Summaries of the latest stratigraphic, radiocarbon, and climatic data are presented for each of these five areas. The Lake Lahontan area is more fully described because of more intensive study; many additional large oscillations were discovered, and three formations and a soil-stratigraphic unit are newly named and defined. The radiocarbon chronologies of Lakes Lahontan and Bonneville are evaluated stratigraphically for comparing the Wisconsin fluctuations of both lakes and of the Rocky Mountain and Midwestern glaciers. Preference is given for interregional correlations of Quaternary successions made by time-stratigraphic classification, and evidence presented for use of weathering profiles (termed "geosols") for long-range correlation, as valid markers more nearly time-parallel than any of the common sedimentary deposits because they are ubiquitous and distinctive.—G.D.C.

1668 **Mudge, M. R.** Rockfall-avalanche and rockslide-avalance deposits at Sawtooth Ridge, Montana: Geol. Soc. America Bull., v. 76, no. 9, p. 1003-1014, 1965.

Sawtooth Ridge in northwestern Montana was the source of three rockfall avalanches on its east side and two rockslide avalanches on its west side. The three rockfall avalanches, which covered about 2,870 acres and had a volume of 850 million cu yd, resulted from the free fall of extremely large cliff segments, possibly resulting from earthquakes, or regional tilt, or loss of support or some combination of the three. The three falls resulted in recession of the ridge scarp by about 1,200 feet. Following the major falls, small segments of the cliff calved off, and frost action and closely spaced joints produced talus. Rock avalanches on the west side of Sawtooth Ridge descended a dip slope, and dammed a gulch in two places; the largest rockslide had a volume of about 10 million cu yd.—S.C.C.

1734 **Muehlberger, William R.** Late Paleozoic movement along the Texas Lineament, *in* Upper Cretaceous asphalt deposits of the Rio Grande embayment—Corpus Christi Geol. Soc., Ann. Field Trip 1965: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 3-11, illus., reprinted 1965.

This paper was originally published in New York Acad. Sci. Trans., ser. 2, v. 27, no. 4, 1965. Ouschita facies rocks in the Marathon region of west Texas are eastward toward the structural belt known as the Texas Lineament. They are absent along the southern margin of the Val Verde basin which lies astride the belt, but can be traced again from about 200 mi southeast near Uvalde to the Ouachita Mountains outcrops. Isotopic ages on the Precambrian basement are progressively older to the west, with rocks south of the zone younger than those north of it and offset about 250 mi. Similar analysis of the Amarillo-Wichita-Arbuckle trend indicates Texas' original position was just west of Florida, a displacement of 500 mi. If the Ouachita and Appalachian systems were continuous until late Paleozoic time, the considerable differences in rock types must be explained. It is proposed that Ouachita rocks formed on an intermediate type of crust.—G.D.C.

1847 **Muehlberger, William R.; Denison, Rodger E.** Precambrian geology of south central New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 62–69, illus., 1964.

The Precambrian rocks are divided into four geologic units—northwest metamorphic area, central granite belt, sediment and diabase belt, and southeast granite-gneiss area. Each is described. An appendix gives petrographic descriptions of basement rocks.—E.S.L.

1705 **Munger, Robert D.** Subsurface exploration mapping, southern Uinta Basin, Castlegate and Dakota-Cedar Mountain Formations: Mtn. Geologist, v. 2, no. 3, p. 141–166, illus., table, 1965.

Subsurface mapping of the Castlegate Sandstone Member of Price River Formation and the Dakota-Cedar Mountain Formation, both widely contrasting Cretaceous intervals, was based on studies of lithologic logs from wells drilled in the Uinta Basin of Utah. The Castlegate is made up of well-winnowed sandstones of littoral origin with depositional strike to the northeast and uniform increase in thickness to the northwest. A northeast trending area of clean sandstone is interpreted as an off-shore bar or beach deposit bounded by lagoonal deposits on the northwest and grading into marine shales of th Mancos Formation to the southeast. The lower sandstone beds of the Dakota Formation intertongue with the Cedar Mountain Formation; both were deposiited in fluvial channels and floodplains. Upper Dakota deposits are partly paludal, and Dakota siltstones in contact with Mancos Shale are marine.—M.C.

Murphy, L. M. *See* Hodgson, J. H. 2123

1820 **Murray, J. W.; Taylor, F. J. R.** Early calpionellids from the Upper Devonian of western Canada, with a note on pyrite inclusions: Bull. Canadian Petroleum Geology, v. 13, no. 2, p. 327–334, illus., 1965.

Calpionellids, the fossilized tests of ciliate protozoans, are described from thin sections of limestone from the Upper Devonian Waterways Formation. This is apparently the earliest known geologic occurrence. Devonian calpionellids are interpreted as a marine planktonic group.—C.A.S.

1891 **Murray, J. W.** Stratigraphy and carbonate petrology of the Waterways Formation, Judy Creek, Alberta, Canada: Bull. Canadian Petroleum Geology, v. 13, no. 2, p. 303–326, illus., 1965.

Seventy thin sections of cores of the Waterways Formation of probable early Late Devonian age, commonly termed Beaverhill Lake Formation, were studied petrographically. The Waterways Formation is a basin facies that envelops an oil-producing, reef-fringed bank in west-central Alberta. It consists largely of nodular, argillaceous, micritic, and micritic skeletal limestone interbedded with massive and laminated micritic limestone and calcareous shale. The skeletal remains are considered to represent a mixed faunal assemblage of pelagic and benthonic forms, and the bottom conditions during deposition are interpreted to have fluctuated between stagnant and oxygenated.—C.A.S.

Mutch, T. A. *See* Gwinn, V. E. 2054

1888 **Naldritt, A. J.** Heazlewoodite in the Porcupine District (Ontario): Canadian Mineralogist, v. 8, pt. 3, p. 383–385, 1965.

Heazlewoodite, Ni_3S_2, was found in six samples of serpentinized peridotite from the Alexo nickel mine. It occurs mostly as single crystals with pentlandite the only other coexisting sulfide. The nearby ore is pyrrhotite, pentlandite, magnetite and minor chalcopyrite. Heazlewoodite is thought to have formed by reaction of sulfur with nickel-bearing silicates.—E.H.R.

1567 **Nathans, M. N.; Smith, D. K.; Kah, J. S.** Iron minerals formed by a nuclear explosion in a salt bed: Science, v. 150, no. 3699, p. 1027, illus., 1965.

The nuclear event, GNOME, was carried out in halite in the Salado Formation and yielded a varied mineral assemblage. The iron support members reacted in the salt melt and formed several iron oxide phases. The magnetite which formed during the fireball stage reacted in various ways with the environment to form higher oxides and hydrated oxides, including lepidocrocite and maghemite.—Authors' abstract

Neiheisel, James. *See* Diment, W. H. 1749

1995 **Nelson, DeWitt.** Role of the Department of Conservation in geologic hazards investigations, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 13–14[1965].

The author proposes three measures for the reorientation and coordination of all geologic work being done in California, to develop and disseminate suitable geologic information in sufficient time to identify the earthquake dangers before development begins, or to minimize dangers inherent in existing works.—E.S.L.

1976 **Nelson, S. J.** Field methods in paleontology: Bull. Canadian Petroleum Geology, v. 13, no. 1, p. 1–138, illus., 1965.

Guide fossils and form genera, which the geologist can roughly and quickly identify in the field with minimum chances for error, are briefly described and illustrated by hand sketches. Fossils that are relatively common and stratigraphically significant in the Paleozoic, Mesozoic, and Cenozoic rocks of western and northern Canada and Alaska are emphasized. The main groups treated are fusilinids, stromatoporoids, graptolites, corals, brachiopods, pelecypods, cephalopods, and trilobites. The probable ranges and anticipated abundance of important forms in these and other groups are charted.—C.A.S.

1865 **New Mexico Geological Society.** Guidebook of the Ruidoso country, 15th field conference, 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, 189 p., illus., tables, geol. map, 1964.

The guidebook includes 22 technical papers plus abstracts of those presented at the 18th annual meeting. Road logs for the three field trips and six supplemental trips are given.—E.S.L.

2094 **Newby, Jerry B.** Charles H. Taylor (1877–1964): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1732–1733, portrait, 1965.

1661 **Newcome, Roy, Jr.** Geology and ground-water resources of the Pascagoula River basin: Mississippi Board Water Commissioners, Mississippi Water News, v. 11, no. 13, p. 1, 1965.

Abundant ground-water resources underlie this Mississippi area in a section 300 to 3,500 feet thick composed mostly of sand and clay of Eocene to Recent age, with the major Miocene and Pliocene rock units represented by the Wilcox, Claiborne, Jackson, and Vicksburg Groups. The Claiborne Group is the major aquifer in the northern third of the basin, while Miocene aquifers are the main source in the southern half and Pliocene at the southern extremity. Quality of the water is good to excellent. Ground-water levels are within fifty feet of the surface so flowing wells are common. While few wells yield more than 500 gpm, yields of 2,000 gpm could be expected. Total pumpage is estimated at 60 mgd but potential ground-water pumpage is many times that figure.—M.C.

2089 **Newman, Karl R.** Upper Cretaceous-Paleocene guide palynomorphs from northwestern Colorado: Colorado Univ. Studies Ser. Earth Sci., no. 2, 21 p., illus., 1965.

Two new form genera and 12 new form species of palynomorphs are described from three outcrop sections of Upper Cretaceous (Campanian and Maestrichtian) and Paleocene formations in the Piceance and Sand Wash basins in Rio Blanco, Routt, and Moffat Counties, Colo. New genera are *Umbosporites* (monolete spores) and *Operculites* (palynomorph of uncertain position). In addition, new species are

assigned to *Kuylisporites* (trilete spores), and the pollen genera *Tricolpites*, *Tricolporopollenites*, and *Triporopollenites* and four other triporate genera. The new species, together with species of *Momipites* and *Sporopollis*, occur in a stratigraphically useful sequence, as shown on occurrence charts for each section.—V.M.J.

1674 **Nielsen, L. E.** Earthquake-induced changes in Alaskan glaciers: Jour. Glaciology, v. 5, no. 42, p. 865–867, 1965.

The earthquake of 27 March 1964 in Alaska created a great number of rock avalanches which discharged onto the glaciers from the surrounding mountains. The ice falls became much more broken up than normal but the remainder of the surface of the glaciers was largely unchanged except for more open crevasses than before the earthquake.—Author's abstract

1879 **Nogan, Donald S.** Foraminifera, stratigraphy, and paleoecology of the Aquia Formation of Maryland and Virginia: Cushman Found. Foram. Research Spec. Pub. 7, 50 p., illus., tables, 1964.

Eighty-nine benthonic and 22 planktonic species of Foraminifera are recognized in the Aquia. Three assemblage zones of planktonic forms show the Aquia to be Paleocene-Eocene in age. Correlation with other Atlantic and Gulf Coastal Plain formations is shown in table and graph. Paleoecologic analyses indicate that the underlying Brightseat Formation, the Aquia Formation, and the basal clay member of the overlying Nanjemoy Formation were deposited in a gradually shoaling sea. In highly glauconitic parts of the Aquia the foraminiferal fauna suggest that the environmental factors important in the formation of glauconite have affected the composition of the fauna.—E.S.L.

1693 **Nordin, Carl F., Jr.; Algert, James H.** Geometrical properties of sand waves [discussion of paper 4055 by M. S. Yalin, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 367–374, illus., table, 1965.

The author's analysis treats the two-dimensional case, which results in an oversimplification of the problem. The relations presented may be useful as first approximations to dune lengths and amplitudes, but some of the basic assumptions are not justified and the results reported do not agree with the writers' observations.—E.S.L.

1666 **North Dakota Geological Survey.** Generalized glacial map of North Dakota: North Dakota Geol. Survey Misc. Map 9, scale about 1 in to 38 mi [1965?].

1739 **North Dakota Geological Survey.** Generalized geologic bedrock map of North Dakota: North Dakota Geol. Survey Misc. Map 8, scale about 1 in to 38 mi [1965?].

Northrup, D. A. *See* Goldsmith, J. R. 2006

2085 **Norwood, E. Earl.** Geological history of central and south-central Montana: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1824–1832, illus., 1965.

The tectonic history of central Montana began with downwarp of the area accompanied by deposition of more than 13,000 feet of Precambrian-Cambrian-Ordovician sediments. Silurian, Lower Devonian, and Middle Devonian rocks are absent. During Late Devonian and Mississippian time, a thick marine sequence of carbonate and shale was deposited and during Pennsylvanian time, a thin nonmarine and marine sequence of clastics and carbonate was deposited. The area was then uplifted and truncated. Deposition resumed in Middle Jurassic and continued through Cretaceous terminating with uplift during the Laramide orogeny.—A.E.R.

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Nussmann, D. G. *See* Driscoll, E. G. 1985

O'Brien, N. R. *See* Smith, W. H. 1886

1973 **Ogden, Lawrence.** Exploration for and engineering geology of an underground protective excavation: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 185–198, illus., 1965.

Sites for newly excavated, deeply buried room-and-pillar opening in bedrock with near-horizontal access tunnels were investigated in the boundary area of the High Plains and the Rocky Mountains. At the site chosen, the principal bedrock unit is a very coarse-grained biotite granite, with minor basic dikes. A major reverse fault, dipping steeply under the mountains, is at the mountain front. Ground water in fractures is of high purity, and the water table is deep and of a low gradient. Geologic advice was of value in selection of a site.—E.S.L.

1876 **Ohio Acad. of Science Sec. Geology.** Upper Paleozoic stratigraphy of Lake and Geauga Counties, Ohio, 39th annual field conference, April 1964: [Columbus, Ohio] Ohio Acad. Sci., 7 unnum. p., illus., 1964.

Strip maps replace the customary written road logs and stops are described. A section at Stebbins Gulch, Chardon Township, from the Chagrin Shale to the Orangeville Formation, Devonian–Mississippian, is included.—E.S.L.

2134 **Ohlen, H. R.; McIntyre, L. B.** Stratigraphy and tectonic features of Paradox basin, Four Corners area: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 2020–2040, illus., 1965.

The Paradox basin, Colorado Plateau, an elongate wedge of northwest-trending Cambrian to Quaternary sediments more than 20,000 feet thick near the Uncompahgre front, is formed by 15,000 feet of Pennsylvanian–Permian arkose along the northeast border, a 6,000–4,000 ft wedge of Pennsylvanian evaporites in the center area, and a peripheral, carbonate facies to the south. The bulk of the oil production comes from block-faulted Mississippian carbonates beneath salt anticlines along the northeast side (Lisbon field), and from plate algal mounds within the Pennsylvanian carbonate facies, in the southeast corner of the basin (Aneth and Ismay fields).—B.H.K.

1549 **Oilweek.** Seismic key to Keg River play: Oilweek, v. 16, no. 37, p. 43–44, 1965.

The advent of computers, new recording equipment and methods have combined to overcome the multiple reflection problem in the Keg River Devonian reefs in northwestern Alberta. With only slight geologic knowledge of the area available, it is possible that geophysicists should be looking for a "pull up" of reflections underlying porous reefs whose velocity might be low compared with dense surrounding layers of a similar lithology. Data processing is used to improve the signal to noise ratio, to deconvolute and dereverberate the signals before stacking them, and to develop a synthetic seismogram that will correlate acoustic data with seismic reflections. New methods do not rule out old seismic records completely.—M.C.M.

1698 **Oilweek.** New tools tackle old problems: Oilweek, v. 16, no. 37, p. 45–48, illus., 1965.

Recently developed tools and techniques in seismic exploration are discussed briefly. The seismic systems approach to solve the stratigraphic trap problem which involves the acoustic log, a synthetic seismogram, and simulation of the anticipated geological problem; techniques of adjustment of geophone layout to individual problems and shooting without holes; the Vibroseis and Dinoseis energy source methods; digital vs. analog recording; and the LaserScan method of optical filtering are examined.—V.S.N.

2103 **Olsson, Axel A.** A review of the genus *Voluta* and the description of a new species: Bulls. Am. Paleontology, v. 49, no. 224, p. 657–671, illus., 1965.

An arrangement for six Caribbean Recent species is suggested, and they are described, including *V. demarcoi*, a new species. Four fossil species from the Miocene of the Caribbean region are also described.—E.S.L.

Orange, A. S. *See* Brace, W. F. 1580

2023 **Ordway, Fred.** A simple method for making stereoscopic drawings: Am. Mineralogist, v. 50, no. 9, p. 1496–1498, illus., 1965.

Satisfactory stereoscopic pairs can be conveniently and quickly produced by arranging paper on a device providing calibrated translational motion, andd plotting the first two atomic coordinates after adjusting the translational setting proportional to the third coordinate.—J.R.C.

Oriel, Steven S. *See* Armstrong, Frank C. 2128

2115 **Osmond, John C.** Geologic history of site of Uinta basin, Utah: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1957–1973, illus., table, 1965.

Cambrian and Mississippian deposits of sandstone and limestone represent marine transgressions from the west. The Uncompahgre Mountain was uplifted in Pennsylvann time, and conglomerate near the uplift grades northward into finer clastics and limestones. Permian through Jurassic deposits represent four marine transgressions from the west and intertongue eastward into thinner non-marine strata. During Cretaceous time the area received 6,000–12,000 feet of Mancos shale and Mesaverde sandstones. Tertiary regional uplift created the Uinta basin, which contains up to 18,000 feet of lower Tertiary fluviatile and lacustrine deposits. W.C.C.

1795 **Osterberg, Charles; Cutshall, Norman; Cronin, John.** Chromium-51 as a radioactive tracer of Columbia River water at sea: Science, v. 150, no. 3703, p. 1585–1587, illus., 1965.

The plume of the Columbia River was followed 350 kilometers to sea by measurement of its chromium-51 content. This radioactive tag, introduced into the river by nuclear reactors at Hanford, Washington, promises to provide a useful oceanographic tool for determining rates of transport and mixing, and for identifying plume waters in the presence of other sources of fresh water.—Authors' abstract

1771 **Otvos, E. G., Jr.** Sedimentation-erosion cycles of single tidal periods on Long Island Sound beaches: Jour. Sed. Petrology, v. 35, no. 3, p. 604–609, illus., 1965.

Sedimentation and erosion during single tidal periods on two Long Island Sound beaches were recorded with colored sand. Deposits commonly were a lower, coarse-grained, poorly sorted, negatively skewed layer and an upper, finer-grained, better sorted, less negatively skewed layer. Exceptions were noted. Depths of erosion were 20–40 percent, or more, of breaker height. "Breaker zone steps" developed with or without breakers. Pebble orientations (long axes) were 20–46 percent within 15 degrees of beach strike. Heavy mineral samples varied widely with hydraulic conditions and mixing of adjoining sand bodies.—E.J.C.

1813 **Outcalt, S. I.; Benedict, J. B.** Photo-interpretation of two types of rock glacier in the Colorado Front Range: Jour. Glaciology, v. 5, no. 42, p. 849–856, illus., 1965.

"Cirque-floor" rock glaciers are believed to represent debris-covered tongues of former glaciers. Most consist of two or more superimposed lobes resulting from independent ice advances. The rock glacier complexes appear to be moving down-slope as single units. Two generations of these "cirque-floor" rock glaciers are tentatively referred to a post-Pleistocene age. "Valley-wall" rock glaciers occur beneath steep valley walls and are supplied with debris by avalanche couloirs. Interstitial ice, responsible for their movement, probably results from metamorphism of snow buried beneath rock-fall debris or supplied by winter avalanching.—from authors' abstract, L.L.R.

Overbey, William K., Jr. *See* Haught, Oscar L. 1667

1981 **Paige, Russell A.** Advance of Walsh Glacier: Jour. Glaciology, v. 5, no. 42, p. 876–878, illus., 1965.

Observations of Walsh Glacier in the St. Elias Range near the Alaska–Yukon border in August 1964 have revealed a recent spectacular advance. Comparisons are made with air photographs taken in 1951, and with Paige's observations in 1952 when he crossed the nearly stagnant terminus. In 1964 the terminal area had become a tremendous maze of chaotic seracs and crevasses pushed out across Logan Glacier for at least two miles beyond its former position and probably still in motion. It is possible that the advance is related to the earthquake of March 27, 1964.—V.S.N.

Paine, W. R. *See* Burdine, E. D. 1916

1554 **Pakiser, L. C.; Kane, M. F.** Gravity study of Owens Valley, *in* Geology and tungsten mineralization of the Bishop district, California: U.S. Geol. Survey Prof. Paper 470, p. 191–195, illus., 1965.

A gravity study of Owens Valley north of Poverty Hills, completed in 1954, covered an area of 300 sq mi; about 300 gravity stations were established and tied to 40 stations previously surveyed in the Bishop area. Field methods, reduction of readings, and interpretation of data are discussed. Qualitative conclusions are reached on the subsurface configuration of the buried bedrock floor and on results of tectonic movements. Three gravity profiles and a Bouguer gravity map are included. Results show that Owens Valley is a deep structural trough filled with about 6,000 feet of Cenozoic sediments. It is concluded that the subsidence of the valley block to its present altitude of 2,000 feet below sea level was continuous or repeated at frequent intervals concurrent with accumulation of clastic rocks and rise of neighboring mountains.—V.S.N.

1555 **Pakiser, L. C.** Seismic profile, *in* Geology and tungsten mineralization of the Bishop district, California: U.S. Geol. Survey Prof. Paper 470, p. 195–196, illus., 1965.

A seismic-refraction profile run along an east-trending road 2 1/2 mi south of Bishop in Owens Valley is discussed. The configuration found for the pre-Tertiary basement corresponds closely with that from gravity data. The greatest depth computed to the pre-Tertiary rocks is approximately 4,800 feet which is considered to be minimum with true depths 500–600 feet greater. The seismic section is illustrated.—V.S.N.

2056 **Palmer, Harold.** Geology of Richardson Rock, northern Channel Islands, Santa Barbara County, California: Geol. Soc. America Bull., v. 76, no. 10, p. 1197–1202, illus., 1965.

Richardson Rock, 10 km west-northwest of San Miguel Island, represents the westernmost visible extension of the broad insular ridge beneath the northern Channel Islands off southern California. The rock is composed of porphyritic dacite, and its structure and orientation suggest that it is the exposed summit of one of many dikes cutting the submerged insular shelf west of San Miguel Island.—Author's abstract

1578 **Parizek, Eldon J.** Kansas City—Its geologic setting: Geotimes, v. 10, no. 3, p. 9–13, illus., 1965.

A summary of the stratigraphy and geomorphology of the Kansas City area is given here for the benefit of first visitors to the city for the meetings of the Geological Society of America. In this area of the confluence of the Missouri and "Kaw" Rivers, the dissected till plains are separated from the nonglaciated Osage Plains at the line where exposed Pennsylvanian beds of the lower Missourian Series slope northwesterly away from the Ozark Mountains. A generalized column is presented of the Kansas City Group which is described briefly.—G.D.C.

1702 **Park, Frederick B.** Equilibrium temperature, Ps_2 and Po_2 during formation of the Marmoraton pyrometasomatic iron deposit: Econ. Geology, v. 60, no. 7, p. 1366–1379, illus., tables, 1965.

Pyrrhotite appears to be in equilibrium with pyrite, is hexagonal, and is relatively pure; frequency distribution for equilibrium temperatures, determined from Arnold's curve, has a maximum at 495°C. At this temperature, the partial pressures of oxygen and sulfur in equilibrium with pyrrhotite–pyrite–magnetite would be about 10^{-20} and 10^{-5} atm., respectively. Closed-system behavior in the orebody is attributed to buffering action of the pyrrhotite–pyrite–magnetite assemblage.—W.S.W.

1952 **Parker, Frank S.** Geologic setting of Beverly Hills and Las Cienegas fields [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1765, 1965.

2061 **Parkinson, L. J.; Helmuth, D. N.** The Swanson River field, *in* Guidebook, field trip routes, Anchorage to Sutton, 1963; Sutton to Caribou Creek, 1964—Oil fields, earthquake, geology: Anchorage, Alaska, Alaska Geol. Soc., p. 25–27, illus., 1964.

This oil field is located in the Kenai Peninsula and was discovered in 1957. Present production is 30,373 bbl per day from horizons in the Tertiary Kenai Formation. The Swanson River anticline is an elongated doubly plunging fold, oriented north–south, and cut by east–trending normal faults. A structure contour map, sections, and an electric log are included.—E.S.L.

1836 **Paterson, W. S. B.** Reply to [M.F.] Meier's letter [1965] on "Variations in velocity of Athabasca Glacier with time": Jour. Glaciology, v. 5, no. 42, p. 875–876, 1965.

The question discussed is the travel time of subglacial run–off. The author agrees with Meier [ibid., v. 5, no. 41, p. 761–762, 1965] that some melt–water reaches the gauging station in a few hours, but thinks it is an open question whether this constitutes a large part of the total. He supports Dr. Meier's plea that high priority be given to further investigation.—E.S.L.

2017 **Pekeris, C. L.** Asymptotic theory of the free torsional oscillations of the Earth: Natl. Acad. Sci. Proc., v. 53, no. 6, p. 1254–1264, tables, 1965.

An asymptotic solution is given for the free torsional oscillations of the Earth of high order n. It is found that in the limit of large n the frequency σ_n is given by an integral which depends only on the distribution of shear velocity $\beta(r)$, and is independent of the density distribution. Values of the free torsional periods $T_n^{appr.}$ computed from this integral for two Earth models are shown to be accurate to one percent or better of $n>10$.—Author's summary

1860 **Perhac, Ralph M.** Notes on the mineral deposits of the Gallinas Mountains, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 152–154, table, 1964.

In the Gallinas Mts. fluorite–copper deposits are located in brecciated zones along faults in the Yeso sandstones and siltstones overlying a trachyte laccolith. The mineralogy of the zones is tabulated. Most show evidence of two periods of hypogene mineralization. Small amounts of gold, silver, lead, and bastnaesite also have been recovered. The five iron deposits are typical limestone replacement lodes in the Yeso limestone at the contact with the laccolith. The mineralogy and origin are discussed.—E.S.L.

1885 **Perhac, Ralph M.** Resume of the geology of the Gallinas Mountains, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 87–91, illus., table, 1964.

The range consists of a granite core overlain by nearly 2,000 feet of Permian clastic sedimentary rocks into which were intruded a variety of alkalic and subsilicic hypabyssal rocks. Doming and faulting accompanied the igneous activity. Petrogenesis of the Permian rocks is discussed along with the stratigraphy. A geologic sketch map and section are included.—E.S.L.

Pernichele, Albert D. *See* Rich, Mark. 1770

1573 **Peterson, James A.** Ice-push ramparts in the George River basin, Labrador-Ungava: Arctic, v. 18, no. 3, p. 189–193, illus., 1965.

In northern regions lake ice rafted ashore sometimes climbs tens of feet as a result of strong and persistent winds during the partial open water season. Lakes Whitegull and Michikamau in Labrador-Ungava are both large exposed lakes with gently sloping shores, upon which boulders are plentiful; the availability of the boulders determines the size of the ramparts. In general they are found on islands and around the shores of Whitegull, Raude and the larger of neighboring lakes, but are unrelated to prevailing winds, probably due to the very short open-water season. Seen from a canoe some ramparts might be taken for raised shorelines, such as are described by Low (1895) at Lake Michikamau. Fossil shorelines of former pro-glacial Naskaupi lakes were too steep to support ice ramparts.—G.D.C.

2116 **Peterson, James A.; Loleit, Allan J.; Spencer, Charles W.; Ullrich, Richard A.** Sedimentary history and economic geology of San Juan basin: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 2076–2119, illus., 1965.

San Juan basin of northwest New Mexico contains up to 15,000 feet of sedimentary rocks ranging from Cambrian to Recent. Thin, incomplete units of Cambrian, Devonian, and Mississippian are overlain by thick Pennsylvanian and Permian, unconformity, Triassic and Jurassic, unconformity, very thick Cretaceous, and thin lower Tertiary, and Quaternary terrace gravels resulting from mountain glaciation. Volcanism occurred during late Tertiary. The section contains much continental sediment and very small amounts of evaporites. Oil and gas are present in Pennsylvanian and Cretaceous beds; 94 million bbl of oil and 3 trillion cfg had been produced to Jan. 1, 1964. Cretaceous beds contain sub-bituminous coal with reserves of about 70 billion tons. Jurassic and Upper Cretaceous beds contain large uranium deposits, reserves estimated at 55 million tons.—S.P.S.

Peterson, W. L. *See* Pohl, E. R. 1752

Petri, L. R. *See* Cotter, R. D. 1594

Petri, L. R. *See* Cotter, R. D. 1703

Petri, L. R. *See* Cotter, R. D. 1719

Petri, L. R. *See* Cotter, R. D. 1796

Petri, L. R. *See* Cotter, R. D. 1799

1983 **Petruk, W.** Relationship between the specific magnetic susceptibility and the iron plus manganese content of chlorite: Canadian Mineralogist, v. 8, pt. 3, p. 372–376, illus., tables, 1965.

The specific magnetic susceptibilities of eleven chlorites were calculated from their chemical compositions and also measured by means of the Frantz isodynamic separator. The calculated values indicate a linear relationship between the specific magnetic susceptibilities and the total iron-plus-manganese content of chlorites. . . . The measured values for eight of the chlorites follow this relationship, but those for the remaining three chlorites deviate from it by substantial amounts.—Author's abstract

2018 **Pierce, W. Dwight.** Fossil arthropods of California—[No.] 26, Three new fossil insect sites in California: Southern California Acad. Sci. Bull., v. 64, pt. 3, p. 157–162, illus., 1965.

Two new species, *Rhyssematus miocenae*, from the Miocene Altamira Shale in Los Angeles County, and *Sobobapteron kirkbyae*, from shale of uncertain age, in the San Jacinto area, are described from wings. Submarine cores are discussed as possible new source of insect wings.—E.S.L.

1846 **Pincus, Howard J.** Retreat of lakeshore bluffs: Am. Soc. Civil Engineers Proc., v. 90, paper 3809, Jour. Waterways and Harbors Div., no. WW 1, p. 115–134, illus., tables, 1964.

A qualitative, descriptive approach to the analysis of retreat of lakeshore bluffs indicates that a large number of factors are significant. Wave action, surface runoff, ground-water seepage, ice and frost action, and slumping appear to be among the more important factors. Quantitative data on soil and rock properties, only sparsely available as yet, do not provide important new insights. However, the data are consistent with the behavior of corresponding materials in lakeshore bluffs. Additional quantitative data and new techniques are needed. Effects of factors, such as degree of cementation, must be quantified.—Author's abstract

1752 **Pohl, E. R.; Cushman, R. V.; Kepferle, R. C.; Peterson, W. L.; Sable, E. G.** (compilers) Geologic features of the Mississippian Plateaus in the Mammoth Cave and Elizabethtown areas, Kentucky—Itinerary, Geol. Soc. Kentucky, Ann. Spring Field Conf., Field Trip, May 1964: Lexington, Ky. Kentucky Geol. Survey, 32 p.,illus., 1964.

After a brief introduction to the geology of these areas, road logs are presented with stratigraphic sections for the Mammoth Cave area, compiled by the first two authors, and for the Elizabethtown area, compiled by the other three. A block diagram illustrates the topographic and geologic control of occurrence and movement of ground water in the Mammoth Cave area.—G.D.C.

2020 **Pohl, E. R.; White, William B.** Sulfate minerals—Their origin in the central Kentucky karst: Am. Mineralogist, v. 50, no. 9, p. 1461–1465, illus., 1965.

Sulfate ion, formed by decomposition (probably speeded by bacterial action) of pyrite moves downward and replaces the carbonate ion in calcite to form gypsum.—E.H.R.

Polk, Robert R. *See* Dillman, C. Daniel. 2101

1568 **Pollack, Henry N.** Steady heat conduction in layered mediums—The half-space and sphere: Jour. Geophys. Research, v. 70, no. 22, p. 5645–5648, illus., 1965.

The general solutions are derived for steady heat conduction in an n-layered half-space and sphere with arbitrary constant heat production and thermal conductivity in each layer and specified flux and temperature at the surface. The solutions are presented in a form convenient for rapid numerical calculations. The given solutions can be readily transformed to allow thermal conductivity to be any function of the local temperature.—Author's abstract

1736 **Pollard, Melvin.** Age, origin, and structure of the post-Cambrian Boston strata, Massachusetts: Geol. Soc. America Bull., v. 76, no. 9, p. 1065–1068, illus., 1965.

The Mattapan Volcanic Complex is dated as late Mississippian, and younger sediments as no younger than earliest Pennsylvanian. Analogy is suggested to the volcanic sequence and structure of the Horton and Windsor Formations in Nova Scotia. This age is believed inconsistent with a glacial origin for the Squantum "tillite." The structure is interpreted as fault block, complicated by later Appalachian orogeny.—Author's abstract

1768 **Polzer, W. L.; Hem, J. D.** The dissolution of kaolinite: Jour. Geophys. Research, v. 70, no. 24, p. 6233–6240, illus., tables, 1965.

The dissolution of natural kaolinite in water systems at 25°C having a pH between 3.2 and 4.0 was monitored for two years by periodically measuring pH and Al and Si concentrations. It was found that (1) silica dissolves from the kaolinite and some form of a silica solid, $SiO_{2(s)}$; (2) the rate of solution of kaolinite is indicated by the rate of solution of Al, therefore the leveling off of Al concentration represents an approach to equilibrium with respect to kaolinite; (3) if this is so, the free energy of formation of kaolinite is -903 kcal per mole.—D.B.V.

Pomeroy, J. S. *See* Lathram, E. H. 1566

1980 **Porter, Fred E.** Oil field abstracts, *in* Geology of the southeastern San Joaquin Valley, California—AAPG, SEG, and SEPM, Pacific Secs., Guidebook 1965: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 16–17, 20–25, 1965.

The Kern Bluff, Ant Hill, Mountain View, Comanche Point, and Tejon Hills oil fields, four areas of the Tejon Grapevine field, and three areas of North Tejon field are described briefly.—E.S.L.

Porter, Stephen C. *See* Czamanske, Gerald K. 1725

1874 **Porter, Stephen C.** Antiquity of man at Anaktuvuk Pass, Alaska: Am. Antiquity, v. 29, no. 4, p. 493–496, illus., 1964.

Geologic evidence from Anaktuvuk Pass, central Brooks Range, indicates that the latest ice advance during the Itkillik glaciation reached its maximum stand between 8,000 and 9,000 years ago. Archeological sites at the pass lie behind a terminal moraine built during this advance and therefore must postdate it. Radiocarbon dates indicate that deglaciated areas existed near the present drainage divide as early as 7,200 years ago, but prior to that time the valley floor was largely buried under stagnant ice. Geologic relationships between the sites and radiocarbon-dated late-glacial sediments place a maximum limiting age of about 7,000 years on the oldest cultural materials.—V.M.J.

2011 **Poschenrieder, Walter P.; Herzog, Richard F.; Barrington, Alfred E.** The relative abundance of the lithium isotopes in the Holbrook meteorite: Geochim. et Cosmochim. Acta, v. 29, no. 11, p. 1193–1195, illus., 1965.

Results of a direct determination of the lithium isotope abundance in the Holbrook meteorite, made with an ion-microprobe mass spectrometer, are reported. The Li concentration was very inhomogeneous over the surface of the sample, in places being below the detection limit of 1 ppm and in others as high as about 100 ppm. In the regions of larger concentration the ratio of mass-peak heights in Li-7/Li-6 varied between 9.5 and 27.5 percent; in a comparison sample of terrestrial hornblende it did not deviate by more than ±8 percent.—D.B.V.

Pouliot, G. *See* Jambor, J. L. 1984

Pratt, P. F. *See* Bradford, G. R. 1811

2000 **Press, Frank.** Research leading to earthquake prediction, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 44–46 [1965].

Studies that can be undertaken now, either in the laboratory or in the field, in the way of measuring rock properties and geophysical aspects of the Earth itself are listed. Various approaches to unifying these in an earthquake-prediction research program are discussed.—E.S.L.

1596 **Prill, R. C.; Johnson, A. I.; Morris, D. A.** Specific yield—Laboratory experiments showing the effect of time on column drainage: U.S. Geol. Survey Water-Supply Paper 1662-B, p. B1–B55, illus., tables, 1965.

The increasing use of ground water from many major aquifers in the United States has required a more thorough understanding of gravity drainage, or specific yield. This report describes one phase of specific-yield research by the U.S. Geological Survey's Hydrologic Laboratory in cooperation with the California Department of Water Resources. An earlier phase of the research concentrated on the final distribution of moisture retained after drainage of saturated columns of porous media. This report presents the phase that concentrated on the distribution of moisture retained in similar columns after drainage for various periods of time. . .—Authors' abstract

Prior, C. H. *See* Cotter, R. D. 1594

Prior, C. H. *See* Cotter, R. D. 1703

Prior, C. H. *See* Cotter, R. D. 1719

Prior, C. H. *See* Cotter, R. D. 1796

Prior, C. H. *See* Cotter, R. D. 1799

1953 **Proffitt, Jack M.** Use of SUE system in marine prospecting [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1766, 1965.

Putnam, George W. *See* Alfors, John T. 2025

2132 **Quigley, M. Darwin.** Geologic history of Piceance Creek–Eagle basins: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1974–1996, illus., 1965.

The Eagle Basin occupies a part of the Maroon trough that began to develop in Early Pennsylvanian time. The early sediments are clastics, carbonates and evaporites. Coarse clastics influenced sedimentary types throughout Triassic and Jurassic deposition. In Cretaceous time black shale and marine sandstones were deposited, then lagoonal and paludal sediments including coal. At the end of Mesozoic time the Eagle Basin was uplifted, folded and faulted, and the Piceance and other basins were formed. All important Paleozoic, Cretaceous and Tertiary oil and gas fields are related to the local improvement of porosity and permeability by fracturing in the sediments encasing the reservoir.—W.C.C.

Radtke, Arthur. *See* Hewett, D. F. 1658

2077 **Ragle, Richard.** Ice flow on a glacier divide, St. Elias Mountains [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 640, 1965.

2022 **Rao, M. S.; Yoganarasimhan, S. R.** Preparation of pure aragonite and its transformation to calcite: Am. Mineralogist, v. 50, no. 9, p. 1489–1493, illus., table, 1965.

Aragonite free of trace impurities can be prepared by adding $CaCO_3$ to an aqueous solution of trichloroacetic acid and aging the precipitate on a water bath. A complete indexed X-ray diffractogram is obtained down to d=0.8015A. The temperature of the endothermic peak of aragonite at 465°C is lowered by the presence of calcite; this fact might explain the wide reported range for this temperature for natural aragonite.—E.Z.

1988 **Rasetti, Franco.** Middle Cambrian trilobites of the Pleasant Hill Formation in central Pennsylvania: Jour. Paleontology, v. 39, no. 5, p. 1007–1014, illus., 1965.

Eleven species of trilobites from the Pleasant Hill Limestone in Blair and Huntingdon Counties are described and illustrated. A new genus, *Blairella* (type species: *B. crassimarginata* n. sp.) is proposed. Other new species are *Alokistocare nasutum, Blainia buttsi, Blairella triangularis, Elrathia grazierensis, Olenoides pennsylvanicus, O. buttsi, Solenopleurella elatifrons* and *S. transversa*. There seem to be no appreciable age differences among the various collections. The faunule is of late medial Cambrian age, as it includes genera known from the *Bolaspidella* zone of the West. Some of the species also occur in the Maryville Limestone of northeastern Tennessee.—Author's abstract

Ratté, James C. *See* Steven, Thomas A. 1809

2121 **Raup, David M.** Crystal orientations in the echinoid apical system: Jour. Paleontology, v. 39, no. 5, p. 934–951, illus., 1965.

Calcite *c*-axis orientation in ocular and genital plates of 88 species (mostly Recent regulars) shows a strong tendency to bilateral symmetry not corresponding to other symmetry of the adult test. The plane of bilateral symmetry apparently is fixed

in the echinus rudiment before metamorphosis; species lacking a true larval stage also lack this symmetry. Apical system crystallography is more variable (generally at the family level) than that of other parts of the skeleton, but nevertheless can be used as an independent phylogenetic character. There is essentially no correspondence between apical system crystal orientations and those of ambulacral and interambulacral plates. The function of crystallographic patterns in the apical system may be navigational.—R.E.G.

1805 **Ray, Louis L.** Geomorphology and Quaternary geology of the Owensboro quadrangle, Indiana and Kentucky: U.S. Geol. Survey Prof. Paper 488, 72 p., illus., tables, geol. map, 1965.

A history of the geomorphic development of an unglaciated area along the Ohio Valley, stressing the effects of the continental glaciers on the alluvial history of the main and tributary valleys, and on the eolian deposits of the adjacent hill lands is given in this report.—W.L.G.

Reeves, C. C., Jr. *See* Dixon, J. R. 1776

Reiland, L. J. *See* Hale, W. E. 1559

2040 **Reineck, Hans-Erich.** Meeresgeologische Reise-Eindrücke von den U.S.A., [Pt.] 1: Natur u. Mus., v. 95, no. 7, p. 297-310, illus., 1965.

A semi-popular account is given of features of the United States coast, as seen from the air and on trips in connection with the Conference on estuaries. Dune islands along the Atlantic and Gulf coasts are described and compared with those in the North Sea. Several oceanographic institutions were visited and are described.—E.S.L.

1825 **Reiter, W. A.** Memorial to Ferdinand Julius Fohs (1884-1965): Geol. Soc. America Bull., v. 76, no. 9, p. P121-P124, portrait, 1965.

1686 **Remson, Irwin; Appel, Charles A.; Webster, Raymond A.** Ground-water models solved by digital computer: Am. Soc. Civil Engineers Proc., v. 91, paper 4330, Jour. Hydraulics Div., no. HY3, pt. 1, p. 133-147, illus., tables, 1965.

Ground-water data may be stored conveniently on punched cards or magnetic tapes. The stored data may be analyzed using computer programs that describe appropriate models of aquifer performance. The finite-difference digital-computer methods were used to predict the effect of a proposed reservoir on water levels in the Old Bridge Sand Member of the Raritan Formation of New Jersey. It is believed that computer-oriented data storage and computation eventually will become routine ground-water techniques.—Authors' abstract

1993 **Renton, John J.; Hunter, Richard G.** A simple technique for the determination of the weight percent of calcite and dolomite in carbonate rocks: West Virginia Geol. and Econ. Survey Circ. 2, 10 p., illus., 1965.

This technique is based on the fact that a straight line relationship exists between the significantly different CO_2 molecular weight percentages of calcite and dolomite, 44 and 47 percent respectively. It also makes use of a commonly reported analytical figure, the amount of evolved CO_2 present. The apparatus for the CO_2 evolution technique is illustrated and the procedure detailed. Advantages and limitations of standard techniques are discussed.—E.S.L.

Ribbe, Paul H. *See* Moore, Paul B. 2012

1770 **Rich, Mark; Pernichele, Albert D.** Petrography of portions of the Duperow Formation (Upper Devonian) in western North Dakota: Jour. Sed. Petrology, v. 35, no. 3, p. 575-588, illus., 1965.

The Duperow Formation is the most widespread Devonian rock unit in the subsurface of North Dakota. It thickens northwestward from its erosional limit in south-central South Dakota to 700 feet in Saskatchewan. The Formation is

dominantly carbonate with some anhydrite, shale, and siltstone. Thin sections of cores indicate six major rock types: fine-grained limestone, calcarenitic limestone, calcarenite, biolithite, anhydrite and associated fine-grained rock, and crystalline dolomite and dolomitized limestone. All transitions occur between these rock types. Limestone pellets and oolites are present in parts of the Formation. Recrystallization and dolomitization of the limestone is widespread.—G.O.B.

Richardson, Everett V. *See* Stepanich, Frederick C. 1845

1851 **Richmond, Gerald M.** Glacial deposits on Sierra Blanca Peak, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 79–81, illus., table, condensed 1964; originally published 1962.

Parts of Article 213 *in* U.S. Geological Survey Professional Paper 450-E, which concern the Pleistocene glacial deposits on Sierra Blanca Peak are given, with a few minor changes. Moraines of the Bull Lake and Pinedale glaciations are described and correlated with those in the Wind River Mountains. A chart showing correlation of these moraines with those on Wheeler and Lake Peaks is included.—E.S.L.

1584 **Richter, D. H.; Herreid, G.** Geology of the Paint River area, Iliamna quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 8, 18 p., illus., table, geol. map, 1965.

In the Paint River area thick greenstone volcanic rocks of Early Jurassic(?) overlie with angular unconformity the Upper Triassic Kamishak Formation. These bedded rocks are intruded by three granodiorite bodies, apparently part of the Middle Jurassic Alaska Peninsula batholith. Contact metasomatic tactites, related to the Pilot Knob granodiorite, occur as lenses and masses in the volcanic rocks or along the unconformable volcanic–sedimentary rock contact. Known iron and copper deposits are restricted to the tactites. Prospecting in the area has been mostly for copper and gold, but the greatest potential may be in the magnetite deposits, which can be delineated by geophysical exploration. Limited magnetometer surveys have revealed a number of anomalies that may be caused by buried tactite bodies. G.D.C.

1659 **Richter, D. H.** Geology and mineral deposits of central Knight Island, Prince William Sound, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 16, 37 p., illus., tables, geol. map, 1965.

The Island is underlain by thick basaltic to andesitic volcanic flows and tuffs with minor interbedded clastic sediments of probable Late Cretaceous age. Thin dikes occur throughout the Island, and larger, coarse-grained sill-like bodies are less abundant. All rocks have been affected by metamorphism of the greenschist facies. The area is folded parallel to the regional NNE structure. Shear zones are present in the massive and pillow greenstones. Massive sulfide deposits in discontinuous pods, lenses, and irregular disseminations, are localized in the shear zones. Mineralization occurred concurrently with the folding, shearing, and metamorphism. The possibility of discovering more massive sulfide deposits appears good. Results of a geochemical survey in the Bay of Isles–Marsha Bay area are included.—E.S.L.

2079 **Roberts, James A.** The reshaping of South Beach, Crescent City, California, after the tsunami of March 27–28, 1964 [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 642, 1965.

2051 **Roberts, Ralph J.; Crittenden, M. D., Jr.; Tooker, E. W.; Morris, H. T.; Hose, R. K.; Cheney, T. M.** Pennsylvanian and Permian basins in northwestern Utah, northeastern Nevada and south-central Idaho: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1926–1956, illus., tables, 1965.

The Oquirrh basin contains Pennsylvanian and lower Permian sedimentary rocks as much as 26,000 feet thick, which consist of a lower part of clastic limestone, sandy limestone, and minor shale; a middle part of cyclically bedded limestone and sandstone, and an upper part of sandstone chert and shale. The Permian Phosphoria

basin contains as much as 3,500 feet of shale, cherty shale, chert, dolomite and limestone. These basins are downwarped segments of the Cordilleran geosyncline superposed on a complex structural pattern of Precambrian and early and middle Paleozoic age. In Cretaceous time, Paleozoic and lower Mesozoic rocks were thrust eastward along the Willard–Charleston–Nebo thrust belt in the Wasatch Mountains.—W.C.C.

Robinson, B. P. *See* Barker, F. B. 1595

Robinson, Charles L. *See* Zagst, Edward F. 1913

1777 **Rogers, J. J. W.** Reproducibility and significance of measurements of sedimentary size distributions: Jour. Sed. Petrology, v. 35, no. 3, p. 722–732, illus., 1965.

Reproducibility of graphically determined statistical measures obtained from sedimentary particle-size distributions is affected by differences in techniques, laboratories, and operators. Major sources of error lie in the mechanics of preparing and using the graphs. Careful use of standard techniques, mutual calibration of results and the use of probability graph paper can reduce the differences in means and standard deviations obtained from different laboratories to where they do not exceed a relatively low tolerance. Greater caution is required to obtain comparable measures of skewness and kurtosis.—R.A.C.

1893 **Rogers, John J. W.; Adams, John A. S.; Gatlin, Beverly.** Distribution of thorium, uranium, and potassium concentrations in three cores from the Conway Granite, New Hampshire, USA: Am. Jour. Sci., v. 263, no. 9, p. 817–822, illus., 1965.

Thorium, uranium, and potassium concentrations have been measured in 1,051 samples from three cores with a total length of 2,700 feet in the Conway Granite of New Hampshire. Thorium and potassium concentrations are generally uniform and probably represent a primary distribution developed during crystallization of the batholith. Uranium, however, is clearly less abundant in surface and near-surface rocks than at depth and has presumably been leached during weathering. These results cast some doubt on the use of outcrop samples for the determination of total radioactivity of large volumes of rock.—Authors' abstract

1911 **Rogers, John J. W.; Longshore, Judith C.** Late Pleistocene and Recent history of portion of Colorado River Valley of Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1753, 1965.

1915 **Romberg, Frederick E.** Optimum use of gravity in exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1754, 1965.

1586 **Rose, A. W.; Saunders, R. H.** Geology and geochemical investigations near Paxson, northern Copper River Basin, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 13, 35 p., illus., tables, 1965.

The oldest rocks mapped in the project are pre-Triassic greenschists and amphibolites which underwent regional metamorphism accompanied by folding, probably in late Paleozoic time, before the eruption or intrusion of greenstone and andesite. Permian shale, limestone, and volcanic rocks were deposited on the north side of the area. The Amphitheatre Basalt erupted in Triassic time and was intruded by gabbro and diorite. Two Jurassic(?) granodiorite plutons intrude the pre-Triassic rocks in the south. The location of these intrusives, with the termination of tectonic trends, suggests a major change in structural pattern approximately along the Richardson Highway. The results of geochemical surveys of stream sediments are tabulated, and copper occurences on Paxson Mtn. are described.—E.S.L.

1587 **Rose, A. W.** Geology and mineralization of the Midas mine and Sulphide Gulch areas near Valdez, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 15, 21 p., illus., tables, geol. map, 1965.

Rock types in the area consist of greywacke and slate of probable Mesozoic age, intruded by basic sills and small diabase plugs. The sedimentary sequence has been metamorphosed to greenschist facies. Copper mineralization is found along the

greenstone belt, and at the Midas mine. Ore at the mine consists of veins containing quartz, pyrite, pyrrhotite, chalcopyrite, and sphalerite following a shear zone subparallel to the foliation. The vein is up to four feet wide on the accessible mine level, but wider portions are reported. The greenstone belt south of the mine extends from Jack Bay at least 15 mi eastward to the Sulphide Gulch drainage. Copper shows occur at several places along the belt, and are closely associated with greenstone. More mapping is needed on the structural features." Stream-sediment geochemistry is given.—E.S.L.

1746 **Rose, A. W.** Geology and mineral deposits of the Rainy Creek area, Mt. Hayes quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 14, 50 p., illus., tables, geol. map, 1965.

The rocks in this central Alaska Range area, range in age from Precambrian schist and gneiss to Tertiary sediments. The oldest ultramafic intrusives were altered to actinolite before intrusion of dunite and gabbro. Along the north side of the area, the schist and gneiss are thrust southward over the younger rocks, and several smaller thrusts and two large normal faults are present in the younger rocks. Copper-nickel deposits are associated with the ultramafic and gabbroic rocks. None of the known copper-nickel showings appear to be of ore grade, but several anomalous stream-sediment samples deserve further prospecting. The mineralogical composition of the rocks and geochemical analyses of stream sediments and rocks are tabulated.—E.S.L.

1662 **Rose, Edward R.** Pyrite nodules of the Timagami copper-nickel deposit: Canadian Mineralogist, v. 8, pt. 3, p. 317-324, illus., 1965.

Porous nodules composed essentially of cellular pyrite . . . appear to occupy relatively smooth-walled cavities within massive chalcopyrite, from which they may be readily separated and removed in places almost intact. Platy ribs and seams of pyrite extend from the nodules into the enclosing mosaic of chalcopyrite crystals, within which they assume a delicate rhombohedral pattern, formed by an intersecting network of chains of minute pyrite cubes. The textural relationships described and illustrated suggest that the nodules may have been formed by recrystallization of pyrite-carbonate-silicate material that was engulfed by fluid magmatic chalcopyrite ore.—Author's abstract

1954 **Rothwell, W. Thomas, Jr.** Regional correlation of Pacific Coast Oligocene microfaunas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1766, 1965.

1831 **Rowell, D. L.** Influence of positive charge on the inter- and intra-crystalline swelling of oriented aggregates of the Na montmorillonite in NaCl solutions: Soil Sci., v. 100, no. 5, p. 340-347, illus., 1965.

In concentrated NaCl solutions, swelling of Na montmorillonite is independent of concentration. Swelling increases rapidly for a small decrease in NaCl concentration. Total swelling is a linear function of the negative log of NaCl concentration, and crystals and pores swell in proportion. Poorly oriented plates may act as links between crystals, the strength of the links depends on the degree of orientation. In second and third stages of swelling the effects of hexametaphosphate, pH, and iron oxides indicate that intercrystalline forces are predominantly edge to face, while intra-crystalline forces are predominantly face to face.—J.W.H.

2043 **Roy, N. N.** A modified spindle stage permitting the direct measurement of 2V: Am. Mineralogist, v. 50, no. 9, p. 1441-1449, illus., table, 1965.

A modified spindle stage has certain advantages over previous models: conoscopic observations can be made using the short working distance of an ordinary polarizing microscope, and the orientation of a mounted crystal can be adjusted. Thus, direct determinations of optic constants, including optic axial angle, are possible. Some results obtained on the potassium-barium feldspar series are presented.—E.Z.

2026 **Roy, Rustum; Buhsmer, Charles P.** Effect of neutron bombardment on the kinetics of some reconstructive phase transformations: Am. Mineralogist, v. 50, no. 9, p. 1473–1477, 1965.

A qualitative discussion is given of neutron bombardment effects on the following transformations: quartz–cristobalite, quartz–coesite, litharge–massicot, calcium orthosilicate polymorphs, silica glass–coesite, and silica glass–quartz. The structural disorder induced is claimed to have an important effect on the rate of some of these polymorphic transformations.—J.R.C.

1977 **Rudel, C. H.** Rock units of the general east side area, Cottonwood Creek to Tejon Hills, *in* Geology of the southeastern San Joaquin Valley, California—AAPG, SEG, and SEPM, Pacific Secs., Guidebook 1965: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 7, chart, 1965.

This is a columnar section including rocks from the Jurassic Edison Schist or granitic basement to the Pleistocene Kern River–Chanac Formations. The generalized lithology and microfossils are given.—E.S.L.

1717 **Rue, Edward E.** The image of the professional geologist—A brief history of positive action: Shale Shaker, v. 16, no. 3, p. 67–69, 1965.

This paper discusses the founding and one of the purposes of the American Institute of Professional Geologists, and its public relations. A review is given of action taken by committees of the American Association of Petroleum Geologists and the American Geological Institute regarding certification of geologists. The author recommends AIPG as covering geologists in all branches of the science, and leading to recognition of geologists by the public.—G.D.C.

1772 **Runnells, D. D.** Anthraxolite derived from indigenous organic matter in Middle Devonian dolomite, Cosmos Hills, Alaska: Jour. Sed. Petrology, v. 35, no. 3, p. 599–603, illus., 1965.

Anthraxolite as scattered grains, irregular veinlets, fracture fillings, and concentrations along stylolitic surfaces in the Middle Devonian wallrock of the Ruby Creek copper deposit in the Cosmos Hills, Alaska, is derived from tiny particles of indigenous organic matter excluded from grains of dolomite during recrystallization. On a moisture-and-ash-free basis the anthraxolite contains (percent) 0.9 hydrogen, 94.5 carbon, and 0.6 sulfur. Moisture-free anthraxolite contains 4.4 percent ash and is not radioactive.—H.A.T.

Russell, R. J. *See* McIntire, W. G. 2078

2080 **Russell, Richard J.; McIntire, William G.** Limestone terraces of Barbados [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 644, 1965.

Rutledge, D. W. *See* Simpson, R. A. 1877

Rutledge, Philip C. *See* Casagrande, Arthur. 2102

2095 **Rutledge, Richard B.** George Rutherford Wesley (1905–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1733–1734, portrait, 1965.

Sable, E. G. *See* Pohl, E. R. 1752

1753 **Sahinen, Uuno M.** Montana University System—Coal Resources Research Council: State Geologists Jour., v. 17, no. 2, p. 25–27, 1965.

Montana, with about one-eighth of the coal reserves of the nation, was once a substantial producer of coal in the West but is now in a depressed condition, much behind other western coal-producing states in recovering from an economic slump since 1957. A coal resources research council has been organized with membership drawn from units of the Montana University System to aid any and all efforts to improve through research.—G.D.C.

1780 **Sahu, B. K.** Theory of sieving: Jour. Sed. Petrology, v. 35, no. 3, p. 750–753, illus., 1965.

Sieve size of a particle is dependent on the length of its intermediate diameter (*b*) and upon the shape of the particle. Geometric analysis proves that for particles just passing through a sieve aperture, a spherical particle will have a smaller *b* than a tabular particle, and a particle with a rectangular cross-section will have a smaller *b* than a particle with an elliptical cross-section. For such reasons the *b* diameter is found to be the best estimate of the ideal true nominal diameter.—R.A.C.

1781 **Sahu, B. K.** Sieving characteristics of symmetrical tabular grains with any roundness value: Jour. Sed. Petrology, v. 35, no. 3, p. 763–765, illus., 1965.

The intermediate diameter (*b*) of a particle which just passes through a sieve aperture varies with shape and roundness of each particle. Tables, graphs, and formulae illustrate and define the relationship.—R.A.C.

1882 **Sainsbury, C. L.; MacKevett, E. M., Jr.** Quicksilver deposits of southwestern Alaska: U.S. Geol. Survey Bull. 1187, 89 p., illus., table, geol. maps, 1965.

The quicksilver mines and prospects of Alaska are scattered widely throughout an area of several thousand square miles, mostly within the drainage basin of the Kuskokwim and Nushagak Rivers. The productive properties comprise one major mine (Red Devil) which produced more than 20,000 flasks of mercury by 1960. The quicksilver lodes are localized in porous zones generally caused by faulting, often near or at the intersection of faults and altered dikes. The ore is cinnabar accompanied by stibnite and other minerals, and was probably deposited where rising hydrothermal solutions met large flows of ground water. New deposits are being discovered currently, and future exploration and prospecting could lead to development of additional mines.—W.L.G.

2081 **Salisbury, Neil E.** Landform–lithologic relationships in portions of the Mississippian Plateaus of Kentucky [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 644, 1965.

2047 **Salotti, Charles A.** Mineralogy and paragenesis of the Cotopaxi, Colorado, Cu–Zn skarn deposit: Am. Mineralogist, v. 50, no. 9, p. 1179–1212, illus., tables, geol. map, 1965.

Mineralization (Precambrian in age) is confined to part of a large xenolith in a granite and is mainly in amphibolite with some in biotite gneiss and sillimanite schist. Primary minerals are scheelite, molybdenite, magnetite, pyrite, pyrrhotite, sphalerite, chalcopyrite, and galena. Four stages can be recognized: amphibolite formation, pegmatoid retrograde, and surficial weathering stages.—E.H.R.

Saunders, R. H. *See* Rose, A. W. 1586

1955 **Savit, Carl H.** Digital seismograms [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1766, 1965.

2060 **Schaff, Ross.** Eagle River Tertiary exposure, *in* Guidebook, field trip routes, Anchorage to Sutton, 1963; Sutton to Caribou Creek, 1964—Oil fields, earthquake, geology: Anchorage, Alaska, Alaska Geol. Soc., p. 24, 1964.

The 27 ft section exposed in the bend of the river near the Glenn Highway bridge consists of carbonaceous siltstone and shale, typical of the Cook Inlet region. One unique bed at the base contains fresh-water pelecypods and gastropods which are correlated with some on Popof Island, and are assigned an early Oligocene age.—E.S.L.

1763 **Scheidegger, Adrian Eugen.** Discussion of paper by P. E. Gretener [1965], "Can the state of stress be determined from hydraulic fracturing data?": Jour. Geophys. Research, v. 70, no. 24, p. 6213, 1965.

Gretener's objections to the conclusions drawn by Scheidegger (ibid., v. 70, no. 24, p. 6205–6212, 1965) and others are based on the questioning of two working assumptions. Scheidegger discusses these two points of issue, showing that Gretener's argument is conceptually faulty. If a refinement of the theoretical model of well fracturing is to be made, the actual generation and propagation of the fracture has to be described dynamically, which is no easy task. All workers on the subject have stated the tentative character of their working assumptions and results; Gretener offers no suggestions for improvement.—D.B.V.

2021 **Schiller, E. A.; Taylor, F. C.** Spessartite-quartz rocks (coticules) from Nova Scotia: Am. Mineralogist, v. 50, no. 9, p. 1477–1481, illus., table, 1965.

Nova Scotia coticules (thin beds, lenses, and nodules of quartz and spessartite garnet) are of sedimentary origin, derived from chemically precipitated silica and manganese, with small amounts of detrital clay. The present assemblage is the result of greenschist regional metamorphism and is stable also in the hornblende hornfels facies. Trace-element data do not confirm the existence of a trace element assemblage characteristic of spessartite of metasedimentary origin. Chemical analysis, index, and cell size of one spessartite are given.—B.C.H.

Schilling, John H. *See* Beal, Laurence H. 1707

1665 **Schmertmann, John H.** In-situ strength characteristics of soft clays [discussion of paper 4274 by I. Noorany and H. B. Seed, 1965]: Am. Soc. Civil Engineers Proc., v. 91, paper 4525, Jour. Soil Mechanics and Found. Div., no. SM6, pt. 1, p. 123–127, illus., 1965.

Schmertmann believes that it is theoretically unjustified to use the Hvorslev linkage as a basis for evaluating *in situ* and laboratory undrained strengths.—E.S.L.

1823 **Schmitt, Harrison A.** The search for ore deposits [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 187–188, 1964.

2090 **Schmitt, R. A.; Smith, R. H.; Haskin, Larry.** Abundances of the 14 rare-earth elements, scandium, and yttrium in the solar system (in meteoritic, terrestrial, and solar matter), *in* Rare earth research II—Rare Earth Research Conf., 3d, 1963, Proc.: New York, Gordon and Breach, p. 582–621, illus., tables, 1964.

Rare-earth element concentrations and distribution patterns in igneous rocks are quite variable, but show that the Earth's crust is enriched in these elements relative to chondrites, and is more enriched in the light elements than in the heavy, for which the chondritic and crustal distributions are apparently identical. The overall crustal pattern is best represented by the distribution in sediments. All evidence is consistent with enrichment of the crust in all rare-earth elements and with selective enrichment of La through Sm due to differentiation of matter of chondritic composition into a planet with core, mantle, and crust. The resulting crustal distribution is probably unique to the Earth.—E.S.L.

1724 **Schneider, William J.** Areal variability of low flows in a basin of diverse geologic units: Water Resources Research, v. 1, no. 4, p. 509–515, illus., tables, 1965.

In the Swatara Creek basin, just east of Harrisburg, Pa., large-scale variations in low-flow characteristics of streamflow are caused primarily by differences in ground-water geology. The natural average minimum flows are lowest (0.01 to 0.10 csm) in the area underlain by the Martinsburg Shale; moderate (0.10 to 0.2 csm)in areas underlain by sandstone, conglomerate, and shale in the northern mountainous part of the basin; greater (0.3 to 0.4 csm) in southeastern part underlain by the Gettysburg Shale, which consists mostly of coarse-grained sandstone. The greatest variability, from zero to over 1.0, is in the area underlain by various limestones and dolomites, although there is reasonable consistency to the low flows within each of the several formations.—G.D.C.

1657 **Schoon, Robert A.** (compiler) Selected formation tops in oil and gas tests in South Dakota drilled before January 1, 1965: South Dakota Geol. Survey Circ. 35, 66 p., illus., tables, 1965.

In tabulated data from drillers logs, abbreviated to conserve space, the Dakota Formation as used is the first relatively continuous sandstone that occurs below the Greenhorn Limestone, and in no case is it implied to include any part of the Fall River Sandstone or older formations. The top of the Minnelusa Group is placed at the top of the Cassa Formation; the top of the Madison Group (undifferentiated) marks the youngest Mississippian rocks in any given test. A persistent shale unit was picked for the Devonian top, rather than establishing the boundaries of the Devonian System. A total of 448 oil tests are listed; the county breakdown is shown on a map. The western fourth of the State has been the site of 74 percent of all drilling activities.—G.D.C.

Schreyer, W. *See* Seifert, F. 1713

1970 **Schultz, Gerald E.** Pleistocene vertebrates from the Butler Spring local fauna, Meade County, Kansas: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 235–265, illus., table, 1965.

Most of the paper is devoted to a systematic discussion of the Butler Spring local fauna. A section of the Kingsdown Formation of the Sanborn Group, in which the Butler Spring and Adams local faunas occur, is given. A table compares five vertebrate Illinoian faunas from southwestern Kansas and western Oklahoma. On the basis of faunal composition, the Butler Spring local fauna is considered to be younger than the Berends–Doby Springs assemblage, but older than the Cragin Quarry local fauna. It is impossible to determine the relative ages of the Butler Spring and Mt. Scott local faunas. Some inferences about the environment in which the Butler Spring local fauna lived are made.—E.S.L.

2106 **Scott, Glen R.; Cobban, William A.** Geologic and biostratigraphic map of the Pierre Shale between Jarre Creek and Loveland, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I–439, scale 1:48,000, separate text, 1965.

The known age of the Pierre Shale in this area ranges from late early Campanian through the early Maestrichtian; thickness ranges from 5,200 to 8,000 feet. Abundant ammonites are used for zoning the shale and revealing structural patterns therein. Collections of fossils from 683 localities were used in preparing the map. *Baculites* were found in the lower shale, lower sandstone, and upper shale units. The upper transition member contains beds intermediate in character between Pierre Shale and Fox Hills Sandstone, and its assignment has, therefore, always been controversial; *Baculites* and *Coahuilites* occur sparingly in these strata.—M.C.M.

1892 **Scott, William H.; Hansen, Edward; Twiss, Robert J.** Stress analysis of quartz deformation lamellae in a minor fold: Am. Jour. Sci., v. 263, no. 9, p. 729–746, illus., 1965.

Orientations of quartz optic axes and poles to deformation lamellae from each of five specimens from a single layer of Tuscarora Sandstone in a minor concentric fold exposed in the Delaware Water Gap define fabric axes a_n, b_n, and c_n as described in Ingerson and Tuttle (1945) and Riley (1947). In all specimens, b_n parallels the Sander fabric axis b, but all a_n and c_n axes do not parallel Sander axes a and c. For the lamellae to have formed late in the folding process, principal stress axes would have to have been refracted through inordinately large angles, hence the lamellae formed either before or early in the process of folding and were passively rotated into their present orientation. Fabric axis a_n can parallel stress axes σ_1, or σ_3, and c_n can parallel σ_1 or σ_3; in these specimens a_n parallels σ_3 and c_n, σ_1.—R.W.T.

1999 **Seed, H. Bolton.** Soil engineering problems, *in* Earthquake and Geologic Hazards Conference, 1964: San Francisco, California Resources Agency, p. 37–43 [1965].

Problems in soil engineering are mostly those due to flow–slides or compaction causing subsidence or tilting of structures. Progress made in understanding the

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phenomena involved and preventing damage of these types is outlined. Steps include experimental model studies, types of analysis, and soil-testing procedures.—E.S.L.

1713 **Seifert, F.; Schreyer, W.** Synthesis of a new mica, $KMg_{2.5}$ $[Si_4O_{10}](OH)_2$: Am. Mineralogist, v. 50, nos. 7–8, p. 1114–1118, illus., table, 1965.

A mica is grown in the system K_2O–MgO–SiO_2–H_2O at 1,000 bars water pressure and 300°–600°C. It grows as a single phase from an initial composition $K_2O{\cdot}5MgO{\cdot}8SiO_2{\cdot}XH_2O$ ($X \geq 2$), and, therefore, is assigned the composition $KMg_{2.5}Si_4O_{10}(OH)_2$, intermediate between dioctahedral and the trioctahedral micas. Its polytype is 1M or 3T, and the mean refractive index is 1.565. It does not break down in runs of 3 weeks and may be thermodynamically stable. Similar micas may exist in nature, especially in potassic ultramafic rocks.—E.Z.

2027 **Seifert, K. E.** Deformation bands in albite: Am. Mineralogist, v. 50, no. 9, p. 1469–1472, illus., 1965.

Deformation bands in low albite (An–7) from pegmatite near Bethel, Maine, are approximately normal to (010). Lamellae of albite twinning maintain constant density, and (010) and (001) have the same position relative to each other, in the host and deformation bands. It is concluded that twin gliding has not been involved in formation of the deformation bands, but movement on (010) planes has occurred, possibly along composition planes of earlier formed albite twins.—B.C.H.

1969 **Semken, Holmes A.; Griggs, Clayton D.** The long-nosed peccary, *Mylohyus nasutus*, from McPherson County, Kansas: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 267–274, illus., table, 1965.

A *Mylohyus* palate was collected from the Sandahl gravel pit in northwestern McPherson County in 1961, and, in 1962, an isolated second lower molar was found in the Flohr gravel pit, about 3 1/4 mi NW of the Sandahl pit. The specimens are described, and compared with Friesenhahn material. The strong resemblance, along with the distribution of *Mylohyus*, shown on a map, lead to the conclusion that these specimens are *M. nasutus*.—E.S.L.

1691 **Sentürk, Fuat.** Geometrical properties of sand waves [discussion of paper 4055 by M. S. Yalin, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 360–364, illus., 1965.

The influence of different parameters on the geometry is discussed and diagrammed.—E.S.L.

1683 **Servos, Gary Gordon.** A gravitational investigation of Niagaran reefs in southeastern Michigan [abs.]: Dissert. Abs., v. 26, no. 2, p. 987, 1965.

1803 **Sever, Charles W.** Ground-water resources and geology of Seminole, Decatur, and Grady Counties, Georgia: U.S. Geol. Survey Water-Supply Paper 1809-Q, p. Q1–Q30, illus., tables, 1965.

A ground-water reconnaissance investigation was made in Seminole, Decatur, and Grady Counties, Ga., to appraise the quantity and quality of ground water available and to provide information for the orderly development of this resource. The principal source of ground water is a series of limestones ranging in age from middle Eocene to early Miocene.—W.L.G.

1565 **Shacklette, Hansford T.** Element content of bryophytes: U.S. Geol. Survey Bull. 1198-D, p. D1–D21, illus., tables, 1965.

Amounts of 33 elements found in mosses and liverworts are compared with those of their substrates and of 1,501 samples of vascular plants from the same area. Most minor elements in bryophytes differ greatly in frequency and/or in amount of occurrence from those in vascular plants: bryophytes have lesser amounts of macro-elements—Ca, Mg, K, and P and are likely to contain more elements in measurable amounts. The content of an elements in a bryophyte is related to that in the substrate only if the substrate has the element

in greater than average amounts. Bryophytes concentrate rare earth elements even when these elements cannot be detected in the substrate. Distinctive patterns of element absorption by bryophyte taxa are indicated but not substantiated by this study.—V.S.N.

1972 **Shaffer, Bernard L.; Wilke, Stephen C.** The ordination of fossil communities—An approach to the study of species interrelationships and communal structure: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 199–214, illus., 1965.

The authors propose to assess the potential of an ordination technique as a means of characterizing ancient communities and fossil species interrelationships in space and time. Three fossil assemblages and an extant bottom-dwelling community from Franz Joseph Fjord, Greenland, have been analyzed as a test of the method. Fossil assemblages include the molluscan fauna of the lower Flagstaff Formation of Utah, and postglacial pollen profiles from the north-central states.—E.S.L.

1778 **Sharma, G. D.** Formation of silica cement and its replacement by carbonates: Jour. Sed. Petrology, v. 35, no. 3, p. 733–745, illus., 1965.

The theoretical aspects of solution of various forms of silica and the changing conditional of pH and Eh with depth in accumulating sediments are discussed with respect to the precipitation of quartz and the replacement of quartz by carbonate.—H.A.T.

1697 **Sharpe, John I.** Field relations of Matagami sulphide masses bearing on their deposition in time and space: Canadian Mining and Metall. Bull., v. 58, no. 641, p. 951–964, illus., tables, 1965.

Masses of pyritic copper and zinc ores are entrapped along the contact zone between two volcanic groups in the Matagami area. The upper limits of the sulphide concentrations tend to form concordant contacts against lava or cherty tuffite units of the younger group; the lower extremities tend to either follow transverse structures or merge with zones of dispersed sulphides. The sulphides are deformed and intruded by folded dykes. Close relations between metallization boundaries and volcanic lithology and stratigraphy, and a preliminary investigation of the fabrics and crystallization temperatures of the sulphide masses, suggest that the copper and zinc (but not necessarily all the iron sulphides) were emplaced at high temperatures during volcanism in near-surface lithological-stratigraphic traps.—Author's abstract

Shaw, Charles E., Jr. *See* Dixon, H. Roberta. 2111

Shebalin, N. V. *See* Hodgson, J. H. 2123

Sherman, G. D. *See* Matsusaka, Y. 1816

2069 **Shier, Dan.** Vermetid reef shoreline in Florida: Coastal Research Notes, no. 11, p. 23–24, 1965.

Wave resistant reefs consisting of fused and intergrown tubes of vermetid gastropods in a matrix of calcareous silt have formed in the outer islands of the Ten Thousand Islands. Reefs are up to nine feet in thickness and may be several hundred feet across. A narrow chain of reefs formed when sea level was about nine feet lower than it is today, and grew upward to keep pace with the rising sea level. Some of the islands are migrating landward by a process of erosion on the exposed side and accretion on the lee side.—E.S.L.

1956 **Shover, Edward F.** Mineralogy of Recent sediments of Lucerne Dry Lake, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1766, 1965.

1957 **Silverman, S. R.** Migration and segregation of oil and gas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1766, 1965.

1569 **Simmons, Gene; Brace, W. F.** Comparison of static and dynamic measurements of compressibility of rocks: Jour. Geophys. Research, v. 70, no. 22, p. 5649–5656, tables, 1965.

The elastic properties of two granites, quartzite, limestone, diabase, fused quartz, aluminum, and steel were calculated as a function of pressure to 10 kb from measured P- and S-wave velocities in three directions. Compressibility calculated from V_p and V_s is within a few percent of that measured directly by strain gages for pressures of 3–9 kb; comparison is also good for fused quartz, steel, and aluminum, and for fine-grained limestone at atmospheric pressure. At atmospheric pressure a discrepancy between static and dynamic values is probably due to the different effects of cracks in the rocks.—D.B.V.

Simons, Daryl B. *See* Stepanich, Frederick C. 1845

1877 **Simpson, R. A.; Rutledge, D. W.** A survey of the petroleum industry in Canada, 1962 and 1963: Canada Dept. Mines and Tech. Surveys Mineral Resources Div. Mineral Inf. Bull. MR 78, 125 p., illus., tables, 1964.

A chapter is devoted to each of the following: production and reserves, exploration and development, transportation, processing, and marketing. The last chapter gives some statistics on the world petroleum industry.—E.S.L.

Siple, G. E. *See* Diment, W. H. 1749

1793 **Sippel, Robert F.; Glover, Everett D.** Structures in carbonate rocks made visible by luminescence petrography: Science, v. 150, no. 3701, p. 1283–1287, illus., 1965.

Using a simple device which should bring the luminescence-petrography technique within the grasp of all interested petrographers, we have examined approximately 250 thin sections of carbonate rocks and minerals. Many new phenomena became apparent.—Authors' abstract

2113 **Slaughter, Bob H.; McClure, William L.** The Sims Bayou local fauna—Pleistocene of Houston, Texas, *in* The deltaic Coastal Plain—Gulf Coast Assoc. Geol. Socs., 15th Ann. Mtg., 1965, Field Trip Guidebook: Houston, Tex., Houston Geol. Soc., p. 59–61, 1965.

Several vertebrate fossil localities have been exposed by straightening and deepening of the channels of Buffalo and Sims Bayous within the City of Houston. Paleoclimatology is deduced from the climatic tolerances of armadillos and other extant species found. Many of the species are currently restricted to areas over a hundred miles farther west and southwest, where rainfall is less. It seems probable that the Sims Bayou local fauna is closely related to Clear Creek and is between 25,000 and 35,000 years old.—E.S.L.

1958 **Sliter, William V.** Laboratory experiments on *Rosalina columbiensis* (Cushman) [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1767, 1965.

1853 **Smith, Clay T.** Geology of the Little Black Peak quadrangle, Socorro and Lincoln Counties, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 92–99, geol. map, 1964; reprinted as New Mexico Bur. Mines and Mineral Resources Circ. 75, 1964.

The quadrangle is a synclinal area lying in the broad gentle trough between the Carrizozo anticline and the complexly folded and intruded beds of the Jicarilla Mountains. The San Andres Formation of Permian age is the oldest exposed rock, with beds of Triassic to Quaternary age overlying it. Tertiary and Quaternary intrusive and extrusive rocks are abundant in the southern and eastern portions. Gold, tungsten, and iron have been mined around the Lone Mountain nordmarkite stock.—E.S.L.

Smith, D. K. *See* Nathans, M. N. 1567

1901 **Smith, Derrell A.** Sealing and non-sealing faults [abs.]: . Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1749, 1965.

Smith, J. Fred, Jr. *See* Albritton, Claude C., Jr. 1808

2003 **Smith, J. V.** X-ray-emission microanalysis of rock forming minerals—[Pt.] 1, Experimental techniques: Jour. Geology, v. 73, no. 6, p. 830–864, illus., 1965.

The problems of calibration in X-ray emission analysis are reviewed in detail theoretically and experimentally for the microprobe at the Applied Research Laboratory, Chicago, and new correction formulas are presented. The recommended procedure is to prepare working curves for each mineral group based on accurate standards, and to use correction formulas only where such standards are not available or where accurate calibration is not necessary, as when an element is present only in very small amount. For the major elements in common mineral groups, an accuracy of 1 to 5 percent (of the amount of the element) may be obtained by these techniques.—R.E.W.

1907 **Smith, Lee A.** Paleoenvironmental variation curves and paleoeustatics [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1752, 1965.

Smith, R. H. *See* Schmitt, R. A. 2090

1886 **Smith, W. H.; O'Brien, N. R.** Middle and Late Pennsylvanian flint clays: Jour. Sed. Petrology, v. 35, no. 3, p. 610–618, illus., 1965.

Flint clays of Middle and Late Pennsylvanian ages in Illinois, Indiana, Ohio, and Pennsylvania consist chiefly of well crystallized kaolinite in units that have a brecciated or conglomeratic texture. At some localities the gray cores of the breccia pieces consist of poorly crystallized kaolinite and illite while the lighter colored outer rims consist of well crystallized kaolinite. The flint clays are interpreted to have originated by leaching and alteration of ordinary fine-grained sediments in acid swamps.—H.A.T.

Snider, Henry I. *See* Elston, Wolfgang E. 1858

Snyder, W. Dale. *See* Blumer, Max. 1758

1704 **Socolow, Arthur A.** In memoriam—Ralph W. Stone [1876–1964]: State Geologists Jour., v. 17, no. 2, p. 32, 1965.

1579 **Sohn, I. G.** GSA meetings, 1954–1964: Geotimes, v. 10, no. 3, p. 18–21, illus., tables, 1965.

This article presents a statistical analysis of the scientific communication and information presented at annual meetings of the Geological Society of America and associated societies in the decade 1955–64. The analysis covers the subject matter of interest, the number of participants and number of papers per person, the percentage of non-members who took part, and the publication of reports compared to abstracts. The contemporary trend in subject matter is shown in a table of subjects and number of papers at each session, and likewise for symposiums.—G.D.C.

1835 **Sorauf, J. E.** Flow rolls of Upper Devonian rocks of south-central New York State: Jour. Sed. Petrology, v. 35, no. 3, p. 553–563, illus., 1965.

Layers of isolated rounded ellipsoidal nodules identified as flow rolls are the most obvious structures in the Chemung facies. The flow rolls are fine-grained sandstone and are underlain by and enfolded in mudstone or siltstone and oriented parallel to the movement of sediment. Intermediate axes range from 4 inches to 3 feet in length. Ratios of intermediate to long axes range from 1:1 to 1:7. Depositional laminae in the rolls define their internal structures which fall into simple basin and complex folded structures. The flow rolls are believed to have originated when sand deposited on top of finer unconsolidated possibly thixotropic sediment,

subsided differentially forming load pockets which were isolated by the engulfing movement of the surrounding mud.—R.A.C.

1878 **Spackman, W.; Thompson, R.** A coal constituent classification designed to evolve as knowledge of coal composition evolves, *in* Internat. Cong. Stratigraphie et Géologie du Carbonifère, 5th, Paris, 1963, Compte Rendu, v. 1: Paris, Louis Jean—GAP, p. 239–254, illus., tables, 1964.

The evolution of coal terminology and classification from von Guembel's paper in 1883 to the present is discussed. A proposed classification of coal constituents, based on macerals, is presented, dividing them into the micrinite, fusinite, exinite, and resinite series. Each series is described and the paths of coalification are diagrammed. This classification is designed to meet the needs of coal petrologists and chemists, geologists, palynologists, and paleobotanists.—E.S.L.

1676 **Spencer, Alexander B.** Alkalic igneous rocks of Uvalde County, Texas, *in* Upper Cretaceous asphalt deposits of the Rio Grande embayment—Corpus Christi Geol. Soc., Ann. Field Trip 1965: Corpus Christi, Tex., Corpus Christi Geol. Soc., p. 13–21, table, 1965.

One belt of silica-deficient igneous rocks nearly coinciding with the Balcones fault zone of South Texas approximately overlies the subsurface Ouachita structural belt. In Uvalde County the number of bodies and diversity of rock types reach a maximum, which is related to the sharp elbow in the arcuate belt and the nearby Uvalde salient. The less common varieties, unfamiliar rather than abnormal, are emplaced at shallow depths as laccoliths, sills and plugs. Their essential mineral constituents and accessories are tabulated. Little study of their petrologic character and relation to sedimentary framework and tectonism has been attempted; lack of outcrop seems to relegate to subsurface geologists the solution of the controversial problem associated with serpentine debris.—G.D.C.

Spencer, Charles W. *See* Peterson, James A. 2116

1904 **Spillers, James P.** Distribution of hydrocarbons in south Louisiana by types of traps and trends—Frio and younger sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1749–1751, 1965.

1845 **Stepanich, Frederick C.; Simons, Daryl B.; Richardson, Everett V.** Control structures for sand-bed channels: Am. Soc. Civil Engineers Proc., v. 90, paper 3895, Jour. Waterways and Harbors Div., no. WW 2, p. 1–18, illus., tables, 1964.

The basic dynamics of flow in sand-bed channels and the knowledge of the mechanics of flow over broadcrested weirs were used to develop a control structure for use in alluvial channels capable of yielding a stable depth-discharge relation. The structure also creates favorable conditions for measurement of the total sediment discharge.—Authors' abstract

Stephenson, David A. *See* Maxey, George B. 1712

1809 **Steven, Thomas A.; Ratté, James C.** Geology and structural control of ore deposition in the Creede district, San Juan Mountains, Colorado: U.S. Geol. Survey Prof. Paper 487, 87 p., illus., tables, geol. maps, 1965.

Silver, lead, zinc, and gold have been mined in the Creede district, principally from veins along faults that formed with subsidence of the Creede caldera concurrently with Tertiary volcanic activity in the central San Juan Mountains. The complex sequence of volcanic events and associated rock units and structures are discussed in detail. The known veins in the district are localized along faults that were active during the last major period of faulting which followed deposition of the Creede Formation—a complex of lake and stream deposits, volcanic ash, and travertine from mineral springs deposited in a structural moat around the caldera. Most of the ore has come from the Alpha-Corsair, Amethyst, and Solomon-Holy Moses faults.—V.S.N.

1971 **Stevens, James B.** Geology of the Meade County State Park area, Kansas: Michigan Acad. Sci., Arts, and Letters Papers 1964, v. 50, p. 215–233, illus., tables, geol. map, 1965.

The stratigraphy of the late Cenozoic beds is discussed, and illustrated by well logs, a measured section, and a conventional table. The heavy mineral contents of some of the sands are tabulated. The area lies within the Meade Trough or Basin, and is of interest as an example of collapse structure resulting from solution of salt and gypsum in the underlying Permian rocks. The basic structure governing the geologic development is the Crooked Creek fault.—E.S.L.

1818 **Stewart, J. A.; Berger, K. C.** Estimation of available soil zinc using magnesium chloride as extractant: Soil Sci., v. 100, no. 4, p. 244–250, illus., 1965.

A laboratory method is described for measuring available zinc in soils using 2N $MgCl_2$ as an extracting solution. The method is simple and straightforward and seems well adapted to routine determinations. It seems to give better measurements than the two methods currently in use.—J.W.H.

1992 **Stewart, Wilson N.** An upward outlook in plant morphology: Phytomorphology, v. 14, no. 1, p. 120–134, illus., 1964.

Origin and evolution of vascular plants is reviewed in the light of morphology of primitive vascular plant organs, with examples from the fossil record beginning with Upper Silurian and Devonian Psilophytales. The telome concept of W. Zimmermann (1930), and interpretations of it by other authors, are discussed. V.M.J.

2107 **Stoneley, Robert.** Microseisms in the Western Atlantic Region, *in* Annals of the International Geophysical Year, 1957–58—V. 30, Seismology: New York, Pergamon Press, p. 67–69, 1965.

Microseism investigations in the United States from 1957–60 are reviewed briefly. These studies conclude that hurricanes, typhoons, and other storms at sea are responsible for generation of microseisms; small microseisms may be generated directly at the storm center but the major generating mechanism at coastal and inland stations is associated with interference of swells near the stations. Special studies that have been published are listed.—V.S.N.

Strong, Daniel M. *See* Branson, Carl C. 1701

1714 **Stumm, Erwin C.** Two new species of trilobites from the Middle Devonian Silica Shale of northwestern Ohio: Michigan Univ. Mus. Paleontology Contr., v. 19, no. 13, p. 163–166, illus., 1965.

Dechenella (Basidechenella) lucasensis n. sp. is described from several specimens including two nearly complete, from the Silica Shale in a quarry at Silica, Lucas County, Ohio. *Greenops chilmanae* n. sp. is described as a nearly complete cephalon, from the same formation and locality.—V.M.J.

Stumm, Erwin C. *See* Hutchinson, Thomas W. 1789

Stumm, Erwin C. *See* Darby, David G. 1791

Sudo, Toshio. *See* Iwamoto, Shigeki. 1727

1959 **Summers, Herbert J.** Ripple marks in motion [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1767, 1965.

Swan, M. L. *See* Kramer, F. S. 1943

1819 **Swartzendruber, D.; Barber, S. A.** Dissolution of limestone particles in soil: Soil Sci., v. 100, no. 4, p. 287–291, illus., 1965.

The equal-reduction hypothesis may be considered as a reasonable first approach to the problem of limestone dissolution, but it appears to leave room for improvement of quantitative aspects. A modified rate equation is suggested which may provide a basis for quantitative dissolution.—J.W.H.

Swindale, L. D. *See* Matsusaka, Y. 1816

1834 **Talwani, Manik; LePichon, Xavier; Heirtzler, J. R.** East Pacific rise—The magnetic pattern and the fracture zones: Science, v. 150, no. 3700, p. 1109–1115, illus., 1965.

The East Pacific Rise is clearly shown by total-intensity magnetic anomaly patterns recorded during several recent traverses. The axis of the magnetic anomaly pattern showing the Rise north of the latitude of San Francisco is offset along what appear to be fracture zones. Most earthquake epicenters are near these offsets rather than on unbroken segments of the Rise. It is unlikely that the offsets are caused by transcurrent faulting, and it is suggested that the different segments of the crest of the East Pacific Rise developed at their present locations.—G.R.S.

1769 **Tanner, W. F.** Upper Jurassic paleogeography of the Four Corners region: Jour. Sed. Petrology, v. 35, no. 3, p. 564–574, illus., 1965.

Entrada Sandstone in New Mexico and Arizona was mostly deposited by winds transporting sediment from north-northeast to south-southwest. Hills in southwestern and central Colorado controlled eolian deposition in northwestern New Mexico. Todilto Limestone accumulated above the Entrada in a lake which covered much of northwestern New Mexico initially, and a much smaller area in the final stages during which wind-blown gypsum sands accumulated in dunes. A high-pressure weather cell over the Pacific Ocean may have produced an arid or semi-arid climate. Sedimentary structures reflect the effects of wind and shallow water currents. Wind ripple-marks were identified. An isopach of the Entrada indicates maximum thicknesses (1,000 feet) along a north-south line through central Utah, the axis of a sinking trough. The margin of a sea to the west and north passed in a direction northeast to southwest across northern Colorado and Utah.—R.A.C.

1905 **Tanner, William F.** Origin of Gulf of Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1751, 1965.

1920 **Tanner, William F.** History of Apalachicola River delta area, Florida [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1756, 1965.

Taylor, Charles. *See* Hewett, D. F. 1658

Taylor, F. C. *See* Schiller, E. A. 2021

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Teague, G. O. *See* Danes, Z. F. 1750

1804 **Teichert, Curt.** Devonian rocks and paleogeography of central Arizona: U.S. Geol. Survey Prof. Paper 464, 181 p., illus., tables, 1965.

This report deals with the Devonian System (Martin Formation) in central Arizona from the upper Salt River, Globe, and Roosevelt areas northwestward as far as Jerome. The stratigraphic sequence begins with a channel sandstone (Beckers Butte Member) and is of Early or Middle Devonian age, followed by a complex of carbonate and terrigenous-detrital rocks of early Late Devonian age. These rocks are transgressive over the Defiance positive area in northeastern Arizona. No early Paleozoic landmass existed in central Arizona. A small area of Devonian rocks at Elden Mountains, north of Flagstaff, has been included in this study because it is remote from other outcropping rocks of Devonian age. Fossil faunas and floras are discussed also.—W.L.G.

1960 **Teitsworth, Robert A.** Geology and development of Lathrop gas field, San Joaquin County, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1767, 1965.

2124 **Terasmae, J.** Surficial geology of the Cornwall and St. Lawrence Seaway project areas, Ontario [with French abs.]: Canada Geol. Survey Bull. 121, 54 p., illus., tables, geol. map, 1965.

Evidence has been found of three different movements of glacier ice—Malone, Fort Covington, and a post-Fort Covington readvance. The Champlain Sea covered the area some 10,000 to 11,000 years ago, and freshwater organic sediments began to accumulate more than 9,430±140 yr B. P., as shown by radiocarbon dating. Palynological studies indicate that the early forest, about 9,500 years ago, was composed of spruce, balsam fir, jack pine, and birch, with a minor component of hardwood species. An improvement in climate followed, and the early boreal forest was replaced by a mixed hardwood forest with pine and hemlock. The clearing of land in historic time was marked by a sudden increase in weed pollen.—Author's abstract

Theisen, A. A. *See* Visser, S. A. 1817

2129 **Thomas, Leonard E.** Sedimentation and structural development of Big Horn basin: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1867–1877, illus., 1965.

The Big Horn basin of north-central Wyoming and adjacent parts of south-central Montana is primarily a Laramide structural basin. Sedimentary rocks from Cambrian through Tertiary with exception of Silurian are present in the basin. Brief descriptions of these rocks and their relation to the tectonics of this region are given. The present basin seems to have begun to form in Late Cretaceous time and took on its present configuration during the period of intense folding and faulting of the Laramide orogeny during the Paleocene and Eocene.—E.K.M.

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1850 **Thompson, Tommy B.** A stratigraphic section of the Sierra Blanca Volcanics in the Nogal Peak area, Lincoln County, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 76–78, illus., 1964.

Sierra Blanca was once described as an intrusive complex, but its dominant volcanic character is now recognized. The section presented extends from the ridge north of Elder Canyon to the top of Nogal Peak. Three thick laterally continuous andesite flows were recognized and used for correlation purposes. The volcanic sequence rests unconformably on the McRae Formation of Tertiary age. The 41 units composing the sequence are described.—E.S.L.

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1576 **Thurber, Walter A.; Kilburn, Robert E.** Exploring earth science: Boston, Mass., Allyn and Bacon, 446 p., illus., tables, 1965.

In response to the mushrooming growth of scientific information, modern science programs emphasize the processes by which information is obtained and made meaningful, and demand modern textbooks. This introductory textbook aims: (1) to bring young people into contact with their environment in such a way as to stimulate a desire to investigate, and (2) to provide them with an understanding of the methods and philosophies of science so that they can carry out investigations with a minimum of direct guidance by teachers. The topics were selected, not because they are currently popular, but because they lend themselves to exploration

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in depth in the laboratory and in the field, giving direct experience with basic scientific research.—G.D.C.

1672 **Tomkins, J. Q.** Polygonal sandstone features in Boundary Butte Anticline area, San Juan County, Utah: Geol. Soc. America Bull., v. 76, no. 9, p. 1075–1080, illus., 1965.

Large sandstone polygons in the Carmel Formation of Jurassic age were formed by eolian infilling of mud cracks with sand, followed by lithification and partial removal of easily eroded siltstone "mold" material.—J.J.H.

Tooker, E. W. *See* Roberts, Ralph J. 2051

1974 **Toomey, D. F.** Upper Devonian (Frasnian) Foraminifera from Redwater and South Sturgeon Lake reefs, Alberta, Canada: Bull. Canadian Petroleum Geology, v. 13, no. 2, p. 252–270, illus., 1965.

Foraminifers, calcispheres, and ostracodes from thin sections of well cores from the Upper Devonian (Frasnian) Leduc Formation of the Woodbend Group in central Alberta are described and illustrated. Distribution patterns of tikhinellid and parathuramminid foraminifers are related to certain textural rock types within the Redwater reef. Correlations are made with sparsely known Devonian foraminiferal occurrences in North America.—C.A.S.

Toulmin, Lyman D. *See* Huddleston, Paul F. 1910

1966 **Trauger, Frederick D.** Ground water in relation to the economy and geology of Grant County, New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 188–189, 1964.

Tryggvason, E. *See* Hodgson, J. H. 2123

2009 **Turner, Francis J.** Note on the genesis of brucite in contact metamorphism of dolomite: Beitr. Mineralogie u. Petrographie, v. 11, no. 4, p. 393–397, illus., 1965.

Available thermodynamic data and published results of experiments relating to formation of periclase from dolomite and hydration of periclase to brucite, permit the following conclusions: 1. At very low partial pressures of CO_2 and relatively high partial pressures of water, dolomite can break down directly to brucite and calcite at temperatures above 400°C, and below the brucite dehydration curve. 2. The reaction dolomite to calcite and periclase plus CO_2 near granitic bodies is likely to occur only at low partial pressures of CO_2, with partial pressure of water of 1,000 bars or more. 3. At low CO_2pressures dolomite may re-form in the cooling stages of metamorphism.—E.S.L.

Turner, Grenville. *See* Merrihue, Craig. 2013

1815 **Turner, R. C.; Brydon, G. E.** Factors affecting the solubility of $Al(OH)_3$ precipitated in the presence of montmorillonite: Soil Sci., v. 100, no. 3, p. 176–181, illus., 1965.

The magnitude of the ion activity product $(Al)(OH)_3$ was independent of pH, degree of Ca saturation, and initial OH/Al mole ratio in solution. There was a relationship between the amount of $Al(OH)_3$ precipitated and the magnitude of $(Al)(OH)_3$; if the amount of $Al(OH)_3$ was large enough, the length of time of reaction also affected the magnitude of the ion activity product.—J.W.H.

Twiss, Robert J. *See* Scott, William H. 1892

2019 **Uda, Masayuki.** On the synthesis of greigite: Am. Mineralogist, v. 50, no. 9, p. 1487–1489, tables, 1965.

Greigite, Fe_3S_4 with a spinel structure, was made by mixing solutions of Mohr's salt and sodium sulfide. The resulting suspension was sealed in an evacuated silica

tube, left for five days at room temperature, heated one hour at 190°C and quenched. X-ray powder data are compared with natural greigite. Magnetic data are given. Infrared absorption spectra showed no peak.—E.H.R.

Ullrich, Richard A. *See* Peterson, James A. 2116

1723 **VanDenburgh, A. S.; Feth, J. H.** Solute erosion and chloride balance in selected river basins of the western conterminous United States: Water Resources Research, v. 1, no. 4, p. 537–541, illus., tables, 1965.

Estimated average rates of annual solute erosion in 11 important western river basins range from 180 tons per sq mi (Willamette basin) to 4.2 tons per sq mi (Gila basin), averaging 58 tons per sq mi for the entire 545,000 sq mi area drained by the 11 rivers. The wide range in tonnage is the result of many causes, among which differences in geology, gross climatic environments, and activities of man are the most important. Although inaccurate, the estimates provide a basis for evaluation of the importance of solute erosion in several river basins of contrasting physiographic, geologic, and hydrologic character.—G.D.C.

1939 **VanHouten, F. B.** Origin of redbeds, unsolved problems [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1761–1762, 1965.

VanLopik, Jack R. *See* Kolb, Charles R. 1918

Vaughn, Peter Paul. *See* Lewis, George Edward. 1556

Vesanen, E. *See* Hodgson, J. H. 2123

1817 **Visser, S. A.; Theisen, A. A.; Mehlich, A.** Long-term influence of decomposing organic matter on various clay minerals: Soil Sci., v. 100, no. 4, p. 232–237, illus., 1965.

Montmorillonite and several other clay minerals were placed in solution with organic matter and allowed to incubate at a constant temperature for seven years. A permanent alteration of montmorillonite took place, and an alumino-silicate of the kaolinite type was formed. Kaolinite was not affected by the same treatment.—J.W.H.

1919 **Wadsworth, A. H., Jr.** Recent deltation of Colorado River Delta, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1755–1756, 1965.

2053 **Wahrhaftig, Clyde.** Stepped topography of the southern Sierra Nevada, California: Geol. Soc. America Bull., v. 76, no. 10, p. 1165–1190, illus., 1965.

Steplike topography confined to granitic rocks forms much of the west slope of the southern Sierra Nevada. Most of the steps face the San Joaquin Valley, but some line the main drainage channels. The stepped topography is thought to be the result of the rapid weathering of buried granitic rocks in relation to the relatively slow weathering of outcrops. Doubtful alternative hypotheses include faulting, differential erosion of dissimilar bedrock or joint systems, and parallel retreat of successive range fronts. The presence of ancient erosion surfaces in the Sierra Nevada is questionable if the proposed hypothesis is valid.—J.G.V.

Wainwright, John E. N. *See* Gross, Eugene B. 2046

2082 **Walker, H. J.** Arctic sand dunes—Process and form [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p.654, 1965.

Wallace, Robert E. *See* Hobbs, S. Warren. 2045

1571 **Wang, Chi-Yuen.** Some geophysical implications from gravity and heat flow data: Jour. Geophys. Research, v. 70, no. 22, p. 5629–5634, illus., 1965.

The negative correlation between the satellite geoid and heat flow distribution suggests that depressions on the geoid are related to hotter and lighter material

in the interior of the Earth, and rises to colder and heavier material. It is calculated that the radiogenic heat sources are located within the outer 100–200 km of the mantle and that the corresponding temperature variation has a maximum amplitude of about 100°C. The corresponding fluctuation of radiogenic heat, ± 1 to $\pm 2 \times 10^{-14}$ cal per cm^3sec, implies an eclogitic upper mantle rather than one of peridotite or dunite composition.—D.B.V.

1961 **Warme, John E.** Some paleoecologic aspects of recent ecology of Mugu Lagoon, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1768, 1965.

1978 **Warne, Archer H.** The White Wolf fault, *in* Geology of the southeastern San Joaquin Valley, California—AAPG, SEG, and SEPM, Pacific Secs., Guidebook 1965: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 8–9, 1965.

The vertical displacement of this great reverse fault reaches many thousands of feet, and it is known to extend for 45 miles. The author has combined selected observations taken from the earthquake literature with conclusions drawn from his own work, to attempt an accurate but brief account of the fault as it is known today.—E.S.L.

Warren, John S. *See* Evitt, William R. 1933

Watson, John D. *See* Casagrande, Arthur. 2102

2122 **Watt, W. Stuart.** Textural and field relationships of basement granitic rocks, Qaersuarssuk, South Greenland [with German abs.]: Medd. om Grønland, v. 179, no. 8, 32 p., illus., geol. map, 1965.

Some textural and field relations of a basement granite in South Greenland are described. The main granite has been formed by granitization but locally there has been later mobilization, mobilized granite intruding non-mobilized granite as dykes. A cross-cutting contact of the granite against a strip of meta-sediment is interpreted as a local late reactivation of the granite that has flushed out the contact to give the sharp, cross-cutting relationship and an intermediate zone formed by contamination. The textures described, principally myrmekite, and albitic rims to plagioclase and myrmekite, are interpreted as due to local changes in ionic concentration resulting in albite growing at the expense of microcline and vice versa. An overall potash-metasomatism has led to the formation of the large potash feldspar porphyroblasts in a granodioritic matrix.—Author's abstract

Weaver, G. D. *See* Holzner, Lutz. 2070

1854 **Weber, Robert H.** Geology of the Carrizozo quadrangle, New Mexico, *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 100–109, illus., 1964.

A broad bajada underlain by beveled Upper Cretaceous rocks occupies most of the central part of the area. The floor of the Tularosa Valley to the west is mantled by basaltic flows of the Carrizozo Malpais. No Precambrian granite crops out in the area and the oldest exposed rocks are of Pennsylvanian age. Overlying beds are Permian to Tertiary. Intrusive rocks have a wide range in composition; characteristic mineral assemblages are described. Structure, mineral deposits, and basalt flows are discussed briefly and analysis on one flow is included. A generalized geologic map and section are also included.—E.S.L.

Webster, Raymond A. *See* Remson, Irwin. 1686

1833 **Weeks, E. P.; Ericson, D. W.; Holt, C. L. R., Jr.** Hydrology of the Little Plover River basin, Portage County, Wisconsin, and the effects of water resource development: U.S. Geol. Survey Water-Supply Paper 1811, 78 p., illus., tables, geol. map, 1965.

Ground- and surface-water are interrelated in the Little Plover River basin area, an area underlain by from 40 to 100 feet of glacial outwash consisting of highly permeable sand and gravel. The effects of ground-water pumpage on the streamflow, and the effects of streamflow diversions on ground-water levels and downstream flow are described. Effects of ground-water development on streamflow are projected for possible durations and rates of withdrawal.—W.L.G.

1570 **Weiss, Rainer; Block, Barry.** A gravimeter to monitor the ${}_0S_0$ dilational mode of the earth: Jour. Geophys. Research, v. 70, no. 22, p. 5615–5627, illus., table, 1965.

A gravimeter designed specifically to monitor the ${}_0S_0$ dilational mode of the Earth is described. The gravimeter is a modified LaCoste design constructed of fused quartz, operated in a high vacuum, and incorporated into an electrostatic null seeking servo. The gravimeter data are digitally Fourier analyzed after passage through a heterodyne tide filter. The observed spectral density of the noise at 20-minute periods is 10^{-7} g per cpm. The noise can be attributed to temperature and tilt fluctuations and is not actual vertical earth noise. The purpose of the experiment is to search for evidence of scalar gravitational field radiation which may drive the ${}_0S_0$ mode.—Authors' abstract

1798 **Weist, William G., Jr.; Jenkins, Edward D.** Hydrology of the Arkansas River valley in the project area, *in* Geology and occurrence of ground water in Otero County and the southern part of Crowley County, Colorado: U.S. Geol. Survey Water-Supply Paper 1799, p. 17–19, tables, 1965.

Quantitative estimates on the water budget of this area of the Arkansas River valley are summarized in tables on the basis of estimates of amounts of ground-water inflow and outflow, evapotranspiration, and recharge from precipitation. About 26 percent of all water diverted for irrigation within the area becomes available for reuse through seepage and return streamflow or by pumping from valley aquifers.—V.S.N.

1802 **Weist, William G., Jr.** Geology and occurrence of ground water in Otero County and the southern part of Crowley County, Colorado: U.S. Geol. Survey Water-Supply Paper 1799, 90 p., illus., tables, geol. map, 1965.

Otero County and the southern part of Crowley County include an area of about 1,500 sq mi in the Arkansas Valley. The strata of Late Jurassic to Recent age which crop out in the area contain five major aquifers—Wisconsin terrace, valley fill and Nebraskan deposits, and the Dakota and Cheyenne Sandstones. All of the ground water can be classed as sodium calcium sulfate bicarbonate in character and generally is of fair to good quality.—W.L.G.

Welday, E. E. *See* McIntyre, D. B. 1669

2052 **Welte, Dietrich H.** Relation between petroleum and source rock: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 12, p. 2246–2268, illus., 1965.

Oil genesis and migration are very closely related to the development of a sedimentary basin, and one source rock can deliver a whole series of different crude oils. This development is basically the result of the progressive thermal degradation of the organic material which was finely disseminated throughout the source rocks. Potential petroleum source rocks from which primary migration has been prevented or retarded by lack of compactability have a good potential for supplying gas.—A.E.R.

1986 **Westermann, G. E. G.** Septal and sutural patterns in evolution and taxonomy of Thamboderatidae and Clydoniceratidae (M. Jurassic Ammonitina): Jour. Paleontology, v. 39, no. 5, p. 864–874, illus., 1965.

Taxonomic revision based on septal fluting and the internal suture indicate descent of Mediterranean *Ermoceras* Douville and boreal *Arkelloceras* Frebold from the hammatoceratid *Abbasites* Buckman or from the Otoididae, rather than from the Stephanoceratidae. Both the Thamboceratidae and Clydoniceratidae descended

from *Ermoceras*, although the two families may have evolved simultaneously rather than successively. *Ermoceras* is placed unequivocally, and *Arkelloceras* provisionally, in the Thamboceratidae. *"Stephanoceras" arabicum* Arkell, *"S.* cf. *psilacanthus* Wermbter", *"Teloceras* cf. *labrum* Buckman", and *"Normannites* cf. *orbignyi* Buckman" are placed in *Ermoceras*; the last three in synonymy with previously known species.—R.E.G.

1880 **Weyl, Richard.** Erdgeschichte und Landschaftsbild in Mittelamerika [with Spanish abs.]: Frankfurt am Main, Germany, Senckenbergische Naturf. Gesell., 175 p., illus., tables, 1965.

Chapters cover volcanoes in Central America; the volcanic island-arc of the Lesser Antilles; welded tuff and landforms produced by it; mountain building and Pleistocene glaciation in the Cordillera de Talamanca, Costa Rica; old and young mountain building in Guatemala; the Antilles, a Pacific structure in the Atlantic area; crustal movements shown in sea-level changes in Barbados; karst topography, bauxite deposits, and reefs in the West Indies; and correlation of mountain building in Central America and the West Indies.—E.S.L.

1828 **Wheeler, E. P., 2d.** Fayalitic olivine in northern Newfoundland-Labrador: Canadian Mineralogist, v. 8, pt. 3, p. 339-346, illus., tables, 1965.

The olivine facies of adamellite intruding anorthosite in northern Newfoundland-Labrador contains an ultramafic segregation high in olivine. Chemical analysis of the olivine indicates a composition close to Fa_{94}. X-ray diffraction patterns indicate some olivine in the adamellite is even higher in iron. In marginal facies of the adamellite lamellar intergrowths of ferrohedenbergite, ferrohortonalite with granular quartz, and eulite indicate ferriferous pigeonite crystallized early, followed by ferrohedenbergite. Ferrohedenbergite exsolution plates formed in the basal plane of the pigeonite. A little eulite and an intergrowth of ferrohortonalite and quartz formed at the expense of the pigeonite. Finally thin exsolution lamellae formed in the pyroxenes. The time relation of pyroxene and olivine is the reverse of that in crystallization of gabbroic magma.—Author's abstract

2067 **Whisonant, Robert C.** Textural comparison of some ancient and modern sediments from low-energy coastal environments: Coastal Research Notes, no. 11, p. 17-19, 1965.

Grain-size distributions in Recent coastal sediments from the Bend area of the northwestern coast of Florida were compared with those from the Mississippian Parkwood Formation in north-central Alabama. It is suggested that the Recent and Parkwood sediments came from essentially equivalent environments of deposition in terms of energy conditions.—E.S.L.

1692 **White, Cedric Masey; MacMahon, Brian.** Geometrical properties of sand waves [discussion of paper 4055 by M. S. Yalin, 1964]: Am. Soc. Civil Engineers Proc., v. 91, paper 4304, Jour. Hydraulics Div., no. HY3, pt. 1, p. 364-367, illus., 1965.

Derivation of the equations relating sand-wave length to stream depth and sand-grain size and their use in diagramming are questioned.—E.S.L.

1801 **White, Natalie D.; Hardt, William F.** Electrical-analog analysis of hydrologic data for San Simon basin, Cochise and Graham Counties, Arizona: U.S. Geol. Survey Water-Supply Paper 1809-R, p. R1-R30, illus., table, 1965.

. . . On the basis of an hypothesized amount and distribution of pumpage, the decline in ground-water levels in the San Simon basin until 1980 is predicted by electrical-analog-model analysis. The predicted decline from 1960 to 1980 is as much as 120 feet in the Bowie area and 160 feet in the San Simon area. By superimposing these decline data on known data for 1960, the altitude of the water level for 1980 is predicted. The correspondence of the projected water-level conditions to future field conditions depends directly on how closely the future pumpage conforms to the hypothesized values, both in areal distribution and the total for the basin.—Authors' abstract

White, William B. *See* Pohl, E. R. 2020

Wichmann, P. A. *See* Marquis, G. L. 1912

Wickens, A. J. *See* Hodgson, J. H. 1751

Wilke, Stephen C. *See* Shaffer, Bernard L. 1972

1551 **Williams, G. L.** Organic walled microfossils aid oil search: Oil and Gas Jour., v. 63, no. 47, p. 108–112, 1965.

This paper is a brief discussion of the history of study, morphology, life cycle, and stratigraphic value of the dinoflagellates (including hystrichospheres) and acritarchs (organic-walled microplankton of unknown affinity).—S.E.F.

2024 **Williams, Sidney A.** A new occurrence of andorite: Am. Mineralogist, v. 50, no. 9, p. 1498–1500, illus., 1965.

Crystals of andorite, enargite, and bournonite occur in the silver ores of the Taylor district, White Pine County, Nev. Crystal forms are described.—M.L.L.

2108 **Willmore, P. L.** The structure of the Earth's crust—The Canadian IGY programme of crustal studies, *in* Annals of the International Geophysical Year, 1957–58——V. 30, Seismology: New York, Pergamon Press, p. 140–143, illus., 1965.

Canadian crustal studies during the IGY were related to the detonation of 2,750,000 lb of high explosive under Ripple Rock in the navigation channel between Vancouver Island and the British Columbia mainland on April 5, 1958. The program included recording of explosions of depth charges in the waters around Vancouver Island, observation of seismic waves from Ripple Rock explosion, and observations along a refraction profile in Alberta. Crustal thicknesses of 65 km or more were indicated in the vicinity of Banff with lower values further west; 32 km was the thickness estimated at Ripple Rock. The Banff figure may refer to length of an oblique ray through the feature rather than vertical depth.—V.S.N.

1677 **Wilson, Charles W., Jr.; Fullerton, Donald S.** Geologic map of the Antioch quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 311-SW, scale 1:24,000, separate text, 1964 [1965].

The text, "Mineral resources summary of the Antioch quadrangle, Tennessee," describes the limestone and phosphate resources of the area. The best source of limestone is the Carters Limestone which is widely exposed and has many good quarry sites available. The Bigby–Cannon Limestone, mostly in the western and southeastern parts of the area, consists of three facies—Cannon, Dove-colored, and Bigby—with an overall thickness of 70–120 feet. The one known phosphate mine and the deposits in the quadrangle are within the area of distribution of the Bigby–Cannon Limestone; exploration for potential deposits should be restricted to this formation in the flat to gently rolling country underlain by thick residuum in the western section.—M.C.M.

Wire, J. C. *See* Burdine, E. D. 1916

2048 **Wones, David R.; Eugster, Hans P.** Stability of biotite—Experiment, theory, and application: Am. Mineralogist, v. 50, no. 9, p. 1228–1272, illus., tables, 1965.

Biotites on the join phlogopite–annite react to form various assemblages involving magnetite, hematite, sanidine, leucite and olivine. Compositions of biotites coexisting with sanidine and magnetite were determined under the governing variables, temperature, fugacity of water and of oxygen. Biotites crystallizing from a magma may follow either an iron-rich or a magnesium-rich trend depending on fugacity of oxygen. The presence or absence of biotite can be used to estimate minimum or maximum water pressure in "granitic" melts.—E.H.R.

2083 **Woodruff, James F.** Frequency distribution of elevations as an index to terrain classification [abs.]: Assoc. Am. Geographers Annals, v. 55, no. 4, p. 658, 1965.

2010 **Woollard, G. P.** The United States program of seismic crustal studies during the IGY, *in* Annals of the International Geophysical Year, 1957–58—V. 30, Seismology: New York, Pergamon Press, p. 168–182, illus., 1965.

The United States marine program of seismic crustal studies during the IGY included studies of surficial bottom sediments and crustal material immediately beneath; about one-fourth were complete measurements of the crust above the M discontinuity. Locations of the various marine studies as shown on a map were in the southeast Pacific, western Caribbean, south Atlantic, Indian Ocean, and Mediterranean Sea. The continental program was based on explosive blasts in the crystalline basement rocks and Precambrian sediments in the Great Lakes Region of the U.S., buried shield area near the head of the Mississippi embayment in southern U.S., high plateau of central Mexico, Andean high plateau of South America, and Andean foothill region. Results of all studies are summarized briefly.—V.S.N.

1962 **Wright, Frederick F.** Sediment tracer studies—Simple fluorescent marking technique[abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1768, 1965.

Wright, Jean D *See* Kesling, Robert V. 1790

2114 **Wyoming Geological Association** (Technical Studies Committee). Geologic history of Powder River basin: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 11, p. 1893–1907, illus., 1965.

The Powder River basin, northeastern Wyoming and southeastern Montana, was part of the broad, relative stable shelf during Paleozoic and much of Mesozoic time. Intense folding and faulting of the Laramide orogeny during latest Cretaceous to early Eocene time gave the basin its present configuration and greatly influenced the areas of accumulation of oil and gas. Sedimentary rocks from Cambrian through Tertiary are divided into eight units and briefly described in relation to the changing tectonic patterns.—E.K.M.

2064 **Yasso, Warren E.** Use of fluorescent tracers to determine foreshore sediment transport, Sandy Hook, New Jersey: Coastal Research Notes, no. 11, p. 7–8, 1965.

Each of four size classes of foreshore sand was color coded with fluorescent coating material. The tracer particles were introduced at mid-swash line on the foreshore surface, two hours before high tide. A sampling line transverse to the foreshore was established 100 feet downdrift from the point of introduction. Observed transport velocity is of the same order of magnitude as the longshore component of theoretical beach drift velocity. Data indicate that an inverse size-velocity relationship prevails in beach drift transport.—E.S.L.

2065 **Yasso, Warren E.** Plan geometry of headland-bay beaches: Coastal Research Notes, no. 11, p. 8–9, 1965.

A headland-bay beach is defined as a beach lying in the lee of a headland subjected to a predominant direction of wave attack. Such beaches usually have a seaward-concave plan shape resulting from refraction, diffraction, and reflection of waves into the shadow zone behind the headland. A logarithmic spiral was tested as an approximation to the shape of these beaches. Four beaches, one in New Jersey and three in California were selected. Results ranged from excellent to good. Centers for three of the best fitting log-spirals lay close to the shoreward portion of each headland.—E.S.L.

Yoganarasimhan, S. R. *See* Rao, M. S. 2022

Young, H. L. *See* Cotter, R. D. 1594

Young, H. L. *See* Cotter, R. D. 1703

Young, H. L. *See* Cotter, R. D. 1719

Young, H. L. *See* Cotter, R. D. 1796

Young, H. L. *See* Cotter, R. D. 1799

1591 **Young, Richard A.; Carpenter, Carl H.** Ground-water conditions and storage in the central Sevier Valley, Utah: U.S. Geol. Survey Water-Supply Paper 1787, 95 p., illus., tables, 1965.

A geologic and hydrologic investigation of the central Sevier Valley, Utah, was made to determine the relation between surface water and ground water and to determine if ground water can be used for irrigation supplies without affecting existing water uses. The valley is divided into five basins and the hydrology of each is discussed. An inflow-outflow analysis is given for the Sevier-Sigurd basin. About 100,000 acre-feet of ground water is discharged by the central Sevier Valley each year by evapotranspiration from wet areas that are infested with phreatophytes. About 35,000 acre-feet of this water could be salvaged by lowering water levels.—W.L.G.

1913 **Zagst, Edward F.; Robinson, Charles L.** Some recent advances in exploration geophysical techniques and data processing [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1754, 1965.

1866 **Zeller, Robert A., Jr.** Geologic controls of silver-lead-zinc replacements in Eureka mining district, southwestern New Mexico [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 189, 1964.

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